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CONTROL OF BACILLARY WHITE DIARRHOEA INFECTION OF POULTRY IN BRITISH COLUMBIA *

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Bacillary White Diarrhoea is known chiefly as an acute, fatal, infectious disease of young chicks. In adult birds the disease is usually chronic, but occasionally it may be acute.

Rettger (*1*) discovered the causative organism of the disease and named it *Bacterium pullorum* (Bergey's classification *Salmonella pullorum*). He and his associates worked out the life history of the parasite, and showed its localization in the ovary of the "carrier" hen and its transmission through the egg.

The rapid spread of the disease during recent years has created a serious problem for the poultry industry. It is apparently present in all parts of the world, and is said to be responsible for more losses in young chicks than any other one poultry disease.

In 1913 Jones(*2*) demonstrated that infected fowls that harbor the disease can be detected by means of a biologic test known as "The Macroscopic Agglutination Test for Bacillary White Diarrhoea." This test, which is based on the same principle as that employed in the diagnosis of contagious abortion in cattle and typhoid and para-typhoid in man, is by many investigators considered highly efficient and the only practicable method now known for controlling the disease. (*3, 4, 5, 6, 7, 8*).

The principle of the agglutination test for Bacillary White Diarrhoea infection in poultry has been applied, with slight modifications in technique, wherever studies of this disease have been made. In some sections of the United States of America, the test has been made compulsory for state inspected flocks, and state-wide testing has been carried on for over a period of ten years.

In such states as Connecticut, Massachusetts, Washington, Oregon and others, the test is at present looked upon as an essential part of the poultry breeder's routine. The cost of the test has been, and still is, a serious obstacle towards its immediate adoption on a nation-wide scale. Furthermore, the technique of the agglutination test is so delicate and sensitive that only properly trained and experienced persons should be entrusted to apply it.

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The skill with which the birds are handled and bled on the farm, the accuracy with which the records are made, the thoroughness with which the reactors are removed from the flock and "follow up measures" are adopted and reinfection guarded against, each and all of these factors influence the success of the Bacillary White Diarrhoea eradication programme. Both the laboratory which is responsible for the accuracy and efficiency of the test and the poultryman who undertakes to carry out his part of the programme are about equally responsible in the successful establishment and maintenance of "Bacillary White Diarrhoea free flocks".

Under an arrangement with the Canadian National Research Council investigations of Bacillary White Diarrhoea infection in the domestic fowl were made by the Department of Poultry Husbandry coöperating with the Department of Bacteriology at the University of British Columbia. The data presented in this paper are, in part, the results of investigations of this disease conducted in British Columbia during the year 1927-1928.

Bacillary White Diarrhoea Infection in Young Chicks

To determine the prevalence of Bacillary White Diarrhoea infection in British Columbia, a questionnaire concerning the disease was sent to a representative body of poultrymen in all sections of the Province. A request was made to poultrymen for reports of any serious outbreaks of disease among young chicks, whatever the cause. In addition, specimens for post-mortem examination were asked for.

Up to September 1, 1927, 41† flock owners had submitted specimens for post-mortem examination, and 110 chicks were subjected to bacteriological, microscopical or such examinations as were required. In Table 1 a summary is given of findings on these examinations. It will be seen from this table that Bacillary White Diarrhoea infection was more prevalent than any other chick disease in the flocks included in this investigation.

Table 1. *Distribution of chick diseases by flocks (Post-mortem examination) Condition or disease.*

	B.W.D.	Chilling	Weaklings	Worms	Coccidiosis	Faulty Feeding	No Diagnosis	Putrid	Total
Number of flocks	15*	1	3	3	8	7	2	2	41
Percentage	36.58	2.43	7.31	7.31	19.51	17.07	4.87	4.87	100

* Two of these flocks showed indications of Bacillary White Diarrhoea infection, but the organism of *S. pullorum* was not isolated from the chicks submitted for examination.

From the fifteen flocks showing indications of Bacillary White Diarrhoea infection 43 chicks, from the ages of one week to six weeks, were bacteriologically examined. In the older chicks distinct lesions were present in the lungs and heart and in several chicks the pericardial cavity was filled with a semi-liquid exudate. In the case of two flocks in which the symptoms and history of the outbreak appeared to suggest Bacillary White Diarrhoea infection, the organism was not isolated but, in these particular cases, only 4 chicks were submitted for examination. From the remaining 13 flocks *S. pullorum* was isolated in pure culture from 21 out of 43 chicks examined.

†The flocks from which chicks were examined were in part identical with those from which blood samples were taken.

The mortality for the fifteen flocks in which Bacillary White Diarrhoea was suspected ranged in most cases around 50 per cent, but in one case the entire flock of 50 chicks died. Another case was particularly interesting in that of 300 chicks chicks bought from one breeder, 35 per cent died, while of 200 chicks purchased from another breeder only 3 per cent died, conditions of rearing being identical. In another case, one breeder reported in three successive hatches, 57.5 per cent, 77.4 per cent and 71.2 per cent mortality, up to three week's of age.

Bacillary White Diarrhoea Infection in Adult Fowls

From the first of March, 1927, to the first of March, 1928, 41† flocks were subjected to the agglutination test, involving 15,327 birds. Of this number of birds 1,745, or 11.3 per cent reacted positive to the test*. (Table 2). Of the 13,817 females, 1,703 or 12.4 per cent, and of the 1,510 males, 42 or 2.7 per cent, reacted positive. These figures are in close agreement with those reported by Rettger, Kirkpatrick and Jones (*9*) and Gwatkin (*10*) on approximately the same number of birds. Of the 41 flocks tested, 16 flocks, or 39 per cent, did not show any indications of Bacillary White Diarrhoea infection. The total number of birds included under the heading of negative flocks was 3,742. In the 25 positive flocks, or 61 per cent of all flocks tested, the percentage of infection varied from less than 1 per cent to 80.4 per cent. 11,585 birds were included amongst the positive flocks.

Table 2. *Distribution of Bacillary White Diarrhoea infection by breeds.*

Breed	Flocks	NUMBER OF BIRDS Males	Females	Total	Negative	Doubtful	Positive Males	Positive Females	Per cent Positive	Not Tested
S.C.W. Leghorns	19*	566	7220	7786	6566	39	17	1111	14.4	53
	6†	407	1637	2044	2028	3	0	0	0	13
	25	973	8857	9830	8594	42	17	1111	11.4	66
W. W. Wyandottes	4*	8	731	739	585	3	0	147	18.6	4
	3†	18	253	271	252	0	0	0	0	19
	7	26	984	1010	837	3	0	147	13.2	23
R. I. Reds	3*	26	512	538	389	0	4	144	26.7	1
	1†	4	24	28	28	0	0	0	0	0
	4	30	536	566	417	0	4	144	26.1	1
B. P. Rocks	2*	15	399	414	305	0	2	107	26.3	0
	1†	8	70	78	70	0	0	0	0	8
	3	23	469	492	375	0	2	107	22.1	8
Miscellaneous	4*	380	1728	2108	1887	7	19	194	10.1	1
	5†	78	1243	1321	1303	0	0	0	0	18
	9	458	2971	3429	3190	7	19	194	6.2	19
Total all Breeds Positive	25*	995	10590	11585	9732	49	42	1703	14.7	59
Total all Breeds Negative	16†	515	3227	3742	3681	3	0	0	0	58
Grand Total all Breeds	41	1510	13817	15327	13413	52	42	1703	11.3	117

* Positive flocks grouped together. † Negative flocks grouped together.

In Table 2 data are presented on all the tested flocks. The birds are grouped according to breeds, sex and reaction to the agglutination test. S.

*A reactor is a bird whose serum will completely or partially agglutinate *S. pullorum* antigen (.5 turbidity on the McFarland Nephelometer) in a dilution of 1 to 50, incubated for 24 hours at 37°C. and 24 hours at room temperature. One c.c. of one per cent solution of Sodium Hydroxide was added to 100 c.c. of the antigen to prevent cloudiness.

†The flocks from which chicks were examined were in part idetnical with those from which blood samples were taken.

C. W. Leghorns constituted the largest group, White Wyandottes ranked second, Rhode Island Reds third, and Barred Plymouth Rocks fourth. Under the heading of miscellaneous breeds flocks were included in which two, three or more breeds were kept, in which it was not possible to segregate the data for the different breeds, as well as a few small flocks of Black Orpingtons, Light Sussex, Anconas, Black Minorcas and Brown Leghorns.

The percentage of infection in the different breeds (Table 2) varied from 26.1 per cent to 6.2 per cent. Rhode Island Reds showed the largest percentage of infected birds, next came Barred Plymouth Rocks, White Wyandottes, and S. C. W. Leghorns, and the miscellaneous breeds. Since in the miscellaneous group heavy and light breeds are grouped together and a large proportion of S. C. W. Leghorns were included, no particular significance should be attached to the low degree of infection recorded in this group. Also the various percentages of infection in each breed can scarcely be taken as indicative of the average degree of infection in the particular breeds, since the number of birds varied from 492 Barred Plymouth Rocks to 9,830 S. C. W. Leghorns, there being only three flocks of the former and 25 flocks of the latter breed respectively. Had an equal or proportionate number of birds and flocks been tested in each breed a better idea would have been obtained of the actual percentages of infection for each breed. The data herein reported agree with those of Rettger (*11*), Beaudette (*12*) and Kaupp and Dearstyne (*13*) who have reported a higher percentage of infection in the heavy breeds than in the light breeds.

A detailed examination of the data summarized in Table 2 reveals the following facts:

All breeds for which data were secured in this investigation were found to be susceptible to Bacillary White Diarrhoea infection. In the case of infected flocks where two, three or four breeds were kept on a farm and the chicks raised together, "carrier" birds were found in each breed. Special interest is attached to a flock in which eight breeds are kept, namely, S. C. W. Leghorns, Barred Plymouth Rocks, White Wyandottes, Rhode Island Reds, Light Sussex, Black Orpingtons, Black Minorcas and Anconas. Infected birds were found in each of these breeds. In two flocks comprising two breeds and in one flock comprising three breeds, infected birds were found in each breed. On three farms where two breeds were kept, none of the birds in either breed reacted to the test. In spite of the fact that the heavy breeds showed a larger percentage of reactors than the light breeds, the degree of infection in different flocks was found to vary irrespective of the breed; for instance in one flock of White Wyandottes 43.6 per cent of the birds reacted to the test, while in three other flocks of the same breed 11.5 and 1.5 and 1.2 per cent respectively of the birds reacted to the test. On the other hand 3 flocks of White Wyandottes did not have a single reactor. The extreme variation in the degree of infection that may exist within a breed is indicated by the following figures which are a part of the information used in preparing Table 2.

S. C. White Leghorns

Flock Number	20	7	17	22	6
Percent of Infection	1.2	1.5	15.2	44.9	80.4

Proportionately fewer males than females were found to be infected. In one flock of 220 cockerels tested 12, or 4.9 per cent reacted to the test. Out of 394 pullets in the same flock 50 pullets, or 12.6 per cent, reacted. The highest degree of infection in males reported in this investigation was 25 per cent. Several flocks that were infected did not reveal a single reacting male by the agglutination test.

The largest flock in which infected birds were found consisted of 1,753 birds, of which 14.7 per cent were infected. The largest flock in which not a single reactor was found consisted of 1,516 birds.

It is interesting to note that pedigreed birds with high official records and birds selected as good specimens of the breed are found among the reactors. This emphasizes the fact that it is not possible to identify reactors by their appearance nor to identify hens by their record. This agrees with data previously published (*14*) which shows that while reactors lay, on the average, fewer eggs than non-reactors, some of them (the reactors) lay very well. A further interesting point brought out by the data on which Table 2 is based is the occurrence of reactors on supposedly well managed poultry plants. This may indicate that the disease can not be eradicated by such measures as are usually implied by 'good' management.

Routes of Infection

The following data, obtained in connection with Bacillary White Diarrhoea testing, demonstrate the insidious nature of the disease, and indicate what may occur in the case of flocks where the disease is present, if adequate measures of control are not promptly adopted.

In one instance, involving 400 birds tested out of a total of 1500 birds in the flock, the percentage of infection was found to be 80.4 per cent. Losses due to heavy mortality in adult birds, poor hatchability and especially poor livability of chicks, have forced the owner of this flock to go out of business.

In another case, an acute outbreak of the disease occurred in the spring of 1926, causing considerable loss of valuable breeding stock. Of 339 birds that survived the outbreak, 51.6 per cent reacted to the test. Of the pullets entered in Record of Performance in the year 1926-27, 27.4 per cent reacted, and of 201 pullets entered in 1927-28, 21.3 per cent reacted to the test.

In another flock (No. 22, Table 4) in which reactors were found to the extent of 4 per cent last year, the percentage this year had increased to 44.9. There are good reasons for believing that such a rapid increase of infection in this flock was due to the fact that raw, infertile eggs from infected birds were fed to the adult birds.

That infection can be brought in through the purchase of day-old chicks from infected flocks is shown in the case of Flocks 16, 27 and 39. In Flock No. 16 three separate tests were made. One lot of 139 birds tested September 24th, 1927, showed 7.9 per cent reactors. A second lot of 139 birds tested December 1st showed 7.1 per cent reactors. A third lot of 139 birds tested December 10th showed 26.8 per cent. This lot of birds, although raised and kept on the same farm as the previous two lots, was purchased as day-old

chicks from Flock No. 39, in which heavy infection was suspected. Flock No. 27, consisting of 136 birds, showed 43.6 per cent reactors. It was traced through the purchase of day-old chicks, to Flock No. 39. In these two cases infection was traced to one and the same flock. The owner of Flock No. 39 disposed of the breed in question, but a test made on another breed on this farm showed 6.2 per cent infection.

The following case merits special attention. The disease was apparently introduced into this flock through the purchase of breeding stock, which was subsequently shown to have been infected with Bacillary White Diarrhoea. Over three hundred birds, involving four breeds, were tested in the fall of 1925 and 1926. Not a single reactor was found. In the spring of 1927 losses in chicks were traced to Bacillary White Diarrhoea. Following a retest of all the birds on the place, reactors were found in two breeds recently purchased from an outside source that had not been previously tested. Since chicks hatched from the various breeds were brooded together, infection took place amongst all the breeds, with the result that when the chicks matured, over 12 per cent of the pullets reacted to the test.

Retest of Flocks

In Table 3 data are presented on flocks, random samples of which were tested at intervals of six to twelve months. Only a small number of birds that were tested the first time (with the exception of Flock 8) were included in the second test. The most important observation to be drawn from this table is that in cases where the first sample in the flock yielded negative results, the second sample, taken some months later, also gave negative results, except where infection was known to have been introduced from outside sources in the interval. The occurrence of a single reactor among 751 negative birds in Flock No. 28 suggests group agglutination rather than *S. pullorum* infection.

Table 3. *Detail of flocks tested at an interval of 6-12 months.*

	FIRST TEST			SECOND TEST		
Flock	No. of Birds Tested	No. of Reactors	Per cent Reactors	No. of Birds Tested	No. of Reactors	Per cent Reactors
1	50	2	4.0	348	13	3.17
4	34	0	0	236	0	0
5	133	0	0	467	0	0
7	110	3	2.7	407	5	1.2
8	114	33	29.2	463	110	23.5
20	196	1	.5	715	9	1.2
22	50	2	4.0	278	125	44.9
24	73	1	1.3	318	13	4.08
28	34	0	0	752	1	.13
31	110	5	4.5	758	51	6.7
33	105	0	0	78	1	1.2
34	114	0	0	218	0	0

Flocks in which a small percentage of infected birds was found on the first test showed approximately the same percentage of infection (on different birds) in the second test. Flock No. 22 mentioned above is an exception to this rule. In this case, raw infertile eggs from the incubators were fed to the pullet flock, and apparently the large increase in the percentage of reactors was due to this factor.

TABLE 4. *Retest on the same individuals in flocks after reactors removed.*

	FIRST TEST			SECOND TEST			
Flock	No of Birds Tested	No. of Reactors	Per cent Reactors	No. of days between 1st & 2nd Test	No. of Birds Tested	No. of Reactors	Per cent Reactors
8	463	110	23 5	273	305	8	2.6
9	835	299	35.8	204	561	15	2.6
15	446	22	4.9	60	376	2	.54
16	278	48	17.2	231	122	2	1.6
18	510	41	8.03	243	427	4	.93
Total	2532	520	20.5		1791	31	1.7

Table 4 shows the results of retests on the remaining birds in a flock, after the reactors were removed. The data show that the agglutination test is highly effective in detecting infected birds, since on the retest the reactors found on the first test having been removed, the remaining birds, negative on the first test, showed a very small percentage of infection. These tests were conducted at intervals of two to ten months, on the same individuals, with the exception of Flock 9. While the application of a single agglutination test has been reported to be 100 per cent effective with some flocks, a single test does not as a rule eliminate all the reactors from an infected flock (Table 4). It would appear, therefore, that when the agglutination test is being applied to an infected flock with the view of eradicating the disease (rather than controlling the disease) the agglutination test should be applied at least a second time to the non-reactors of an infected flock (after the reactors have been removed on the first test) before they are bred. If only a single test is applied yearly the eradication of Bacillary White Diarrhoea infection will of necessity (because of the nature of the disease) involve an indefinite period of years. A second test usually detects additional reactors in a flock in which infected birds were found, thus indicating that progressive infection may have taken place prior to or after the first test was made (*15*). In Flocks 15, 16 and 18, the reactors were removed immediately following the test. In Flock 8, through a mistake on the part of an attendant, about 25 reactors were retained in the flock, thus exposing a number of birds to further infection after the first test was made. In Flock 9 the owner did not remove all the reactors at once, and furthermore kept some of the reactors for further retests, with the result that the percentage of infected birds was not as effectively reduced as in the case of Flocks 15, 16 and 18. Also, a number of birds not tested previously were introduced on the second test. Table 4 also shows that in five flocks the total average infection was reduced from 20.5 to 1.7 per cent by removal of reactors after the first test. Had *all* the reactors been promptly removed in each flock, the percentage of infection would, undoubtedly, have been still less. The high value and efficiency of the test, as a means of eradicating the disease, are thus clearly demonstrated.

LIVABILITY OF YOUNG CHICKS

The practical benefits to be derived from the agglutination test should be evident in the improved livability of chicks from flocks where reactors were found and subsequently removed. There is very little exact information available on this subject, the data necessarily depending upon the in-

formation supplied by the poultrymen. Through the office of R.O.P. Poultry Breeders' Association of B. C., which is handling the sales of a large number of chicks, we were enabled to check up on the livability of chicks from different breeders by the number of complaints received from their customers, and by requests for adjustments and post-mortem examinations.

As the result of this year's observation in connection with the sale of day-old chicks from tested and untested flocks, Professor E. A. Lloyd, Secretary-Treasurer of the R.O.P. Association, in a circular letter to the members of the Association stated:

"The results of the agglutination test for Bacillary White Diarrhoea have been so successful that we must recommend and urge that all our poultrymen who wish to produce chicks that will live and thrive uniformly should test all the breeding birds they possibly can this year. Remarkable changes for the better have taken place in several different flocks that have been tested and the 'carriers' eliminated."

Data obtained on the livability of chicks prior and subsequent to the removal of reactors do not readily lend themselves to presentation in tabular form. A brief summary of each case is, therefore, deemed to be the most suitable way of presenting the data. Cases 1 to 5 deal with flocks in which all of the breeders were tested and reactors removed. Without exception, considerable improvement in the livability of chicks, as compared with previous years, was reported. Since no complaints were received this year from any of the owners or customers, as was the case last year, no opportunity presented itself to hold post-mortem examination on chicks that died and which were apparently considered as normal losses. It is, therefore, impossible to state whether *S. pullorum* was or was not present in the chicks that died. Cases 5 to 12 deal with flocks in which only a part of the flock was tested (usually ⅓ to ½). In some flocks the reactors from the tested birds were removed, while in others all of the reactors were retained in the flock. In each case, however, reactors and non-reactors were deliberately bred from. In practically every instance, disastrous results followed, as judged by reports from owners and customers, post-mortem examination of chicks and recovery of *S. pullorum*. It is particularly significant to note that nearly all owners of infected flocks have expressed the desire to have some or all of the breeders tested for the disease.

It will be further seen from an examination of the individual cases, that the improvement in livability of chicks was in some instances attributed solely to the removal of the reactors. In certain other cases, some credit should perhaps be given to the improved conditions of hatching, rearing and feeding of chicks this year as compared with last year. The degree of success in raising chicks that should be attributed to the elimination of Bacillary White Diarrhoea and improved conditions is not known and remains to be investigated. This point deserves much more attention than it has hitherto received. Breeders are only too prone to attribute losses in chicks known to be caused by Bacillary White Diarrhoea to such factors as chilling, overheating, faulty feeding, etc. In this connection it may be of particular interest to note that data collected on the livability of chicks from flocks in which no reactors were found show that the chicks are raised with negligi-

ble losses and are known to do well both for the breeder and for his customers, under all kinds of conditions.

A comparison of the chick mortality in the spring of 1927 and 1928 in tested flocks is briefly given in the following cases:

REPORTS FROM OWNERS OF FLOCKS WHERE ALL BREEDERS WERE TESTED

Case 1. In 1927 previous to the removal of the reactors (14.7 per cent) losses of chicks averaged about 30 per cent. In 1928 after the removal of all reactors, losses averaged less than 5 per cent. In this case chicks were fed buttermilk *ad lib.*, and some credit for the good livability of chicks should perhaps be attributed to this factor.

Case 2. In 1927 previous to testing (35 per cent reactors) losses varied from 35 per cent to 50 per cent. In 1928 after the removal of the reactors owner reported normal mortality. Improved livability of chicks attributed by owner solely to the removal of the reactors.

Case 3. 4.9 per cent reactors. In 1927 losses were above those of previous years when no reactors were present in the flock. In 1928 after the removal of the reactors, which were apparently introduced in the flock in 1926, losses of chicks were reported as being negligible.

Case 4. Previous to testing in 1927 (23.5 per cent reactors), Bacillary White Diarrhoea had been suspected in this flock for a period of four years. Complaints were received from many customers each year. In 1928 owner reported great improvement in hatchability of eggs and 3 per cent mortality in chicks up to three weeks of age. No complaints were received this year from customers.

Case 5. 17 per cent reactors. In 1927 losses varied from 25 per cent to over 50 per cent. In 1928 mortality reported normal and chicks thriving uniformly, in spite of crowded conditions.

REPORTS FROM OWNERS OF PARTIALLY TESTED FLOCKS

Case 6. 15.2 per cent reactors. Part of flock tested. Owner reported considerable difference in favour of chicks hatched from non-reactors.

Case 7. 11.5 per cent reactors. 1-3 of flock tested. Owner experienced extreme difficulty in raising chicks in 1927. Chicks wilted and died up to 75 per cent to 80 per cent of the number hatched. In 1928 numerous complaints were received from customers. *S. pullorum* isolated from chicks sent in on three occasions. Owner reports that "chicks hatched from non-reactors have given splendid results, both in our hands and with our customers. Will have every breeder (2000) tested this year."

Case 8. 4.08 per cent reactors. 1-3 of flock tested. *S. pullorum* isolated from chicks sent in by customers, mortality over 50 per cent. Losses on owner's farm not reported.

Case 9. 44.9 reactors. 1-3 of flock tested. Reactors were not removed. Several customers made complaints. *S. pullorum* isolated from chicks sent in by a customer. Owner reported varying results. Will have every breeder (1500) tested this year.

Case 10. 80.4 per cent reactors. Hatchability and livability poor. Practically all customers complaining. Owner went out of business in 1928.

Case 11. 6.2 per cent reactors. Livability of chicks fair. Many customers dissatisfied. Owner sceptical about the value of the test.

Case 12. 24 birds tested. 75 per cent reactors including an infected male. One customer reported 92 per cent mortality; *S. pullorum* isolated from four chicks submitted for examination. Another customer reported 60 per cent mortality; *S. pullorum* isolated from 2 chicks submitted for examination. Many other customers complained, but did not submit chicks for examination. Chicks on owner's farm reported to do well.

SUMMARY

Data secured from an investigation of Bacillary White Diarrhoea—a disease which is acute in young chicks and chronic in adult birds—are presented. The information secured may be briefly summarized as follows:

1. Fifteen of the forty-one flocks included in this investigation showed indications of Bacillary White Diarrhoea infection. *S. pullorum* was isolated from chicks in 13 out of the 15 flocks.

2. Bacillary White Diarrhoea infection of adult birds was found in 25 out of 41 flocks to which the agglutination test was applied.
3. Out of 15,327 tested birds, 1,744, or 11.3 per cent, reacted to the agglutination test.
4. The percentage of infection in flocks tested varied from less than 1 per cent to 80.4 per cent.
5. All breeds were found to be susceptible to Bacillary White Diarrhoea infection. The degree of infection varied considerably within each breed.
6. Males were found to be subject to Bacillary White Diarrhoea infection, but there appeared to be a smaller percentage of infection among them than among the females.
7. Infection was shown to be introduced into the flocks or further spread within the flocks, by:
   (a) Introduction of infected breeding stock;
   (b) Purchase of day-old chicks from infected flocks;
   (c) Feeding of raw eggs from infected birds.
8. The agglutination test was found to be highly effective in detecting birds infected with Bacillary White Diarrhoea, as shown by the fact that the percentage of infection was appreciably reduced after one test and the removal of reactors.
9. Bacillary White Diarrhoea infection was found to have adversely affected the livability of chicks, causing heavy losses. With the removal of reactors from infected flocks, marked improvement in the livability of the chicks was recorded.
10. It is concluded on the basis of the data presented in this report that Bacillary White Diarrhoea infection may be effectively controlled by means of the agglutination test.

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FERTILIZERS FOR WOODED SOILS

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The wooded soil belt constitutes about two-thirds of the entire area of Alberta. It coincides in general with the forest area of the province, and is found to the north and west of the park area. The forest covering in the southern portion is generally of a poplar association, whereas in the northern part this gives way to an evergreen association.

Within the wooded soil belt are to be found local areas of parkland soils which belong to the black soil belt. Examples of such parkland areas are found around High Prairie, between Peace River and Dunvegon; around Spirit River, Grande Prairie and other similar districts. These contain soils of very high fertility and may have a total area of possibly 2,000,000 acres, but they constitute only a relatively small percentage of the total area within the wooded soil belt. Within the wooded soil belt are to be found soils varying in all degrees between the typical parkland soils and the typical wooded soils. However, the greater part of the soils within this major belt belong to the poorer phases of the wooded soils.

The wooded soils in general are much less fertile than the soils of either the parkland (black soils) area or the plain (brown soils) area. The former has been produced largely under the influence of a covering of trees. This incidentally has materially increased the rate and extent of leaching in these soils. The rainfall for this belt varies from 16 to 18 inches.

Typical wooded soils in Alberta have the following general characteristic profile. The upper layer or horizon A_0 consists largely of organic matter varying in thickness from 1 to 4 inches. Immediately under this there is a very thin layer, A_1, of drab to brown coloured mineral soil which varies in thickness from ½ to about 2 inches. The A_1 layer is not always present in the wooded soils. This second layer is underlaid by a light coloured badly leached A_2 layer varying in thickness from 4 to 12 inches. Below the leached light coloured layer is found a somewhat darker coloured B_1 layer, which is much heavier in texture than the above layers, and contains large quantities of the finer clay particles, which have passed downward during processes of leaching. This layer varies in thickness from about 1 to 4 feet. The B_2 or lime layer is not encountered in these wooded soils nearer the surface than from 4 to 6 feet. From the above statement it will be understood that the wooded soils have suffered rather extensive leaching. This explains the fact that they are at present slightly acid in reaction. The leached layers—A_1 to B_1 inclusive—vary in acidity from about pH 6.8 to 6.0.

The nature of these wooded soils may be somewhat better understood by referring to Figure 1 which represents the arrangement of the various horizons found in the soil profile. This shows a relatively thin A_0 horizon, as well as leached horizons A_1 to B_1. It may be noted that the leached horizons occur very near the surface. When such soils are plowed, the entire field often has a light coloured ashy appearance.

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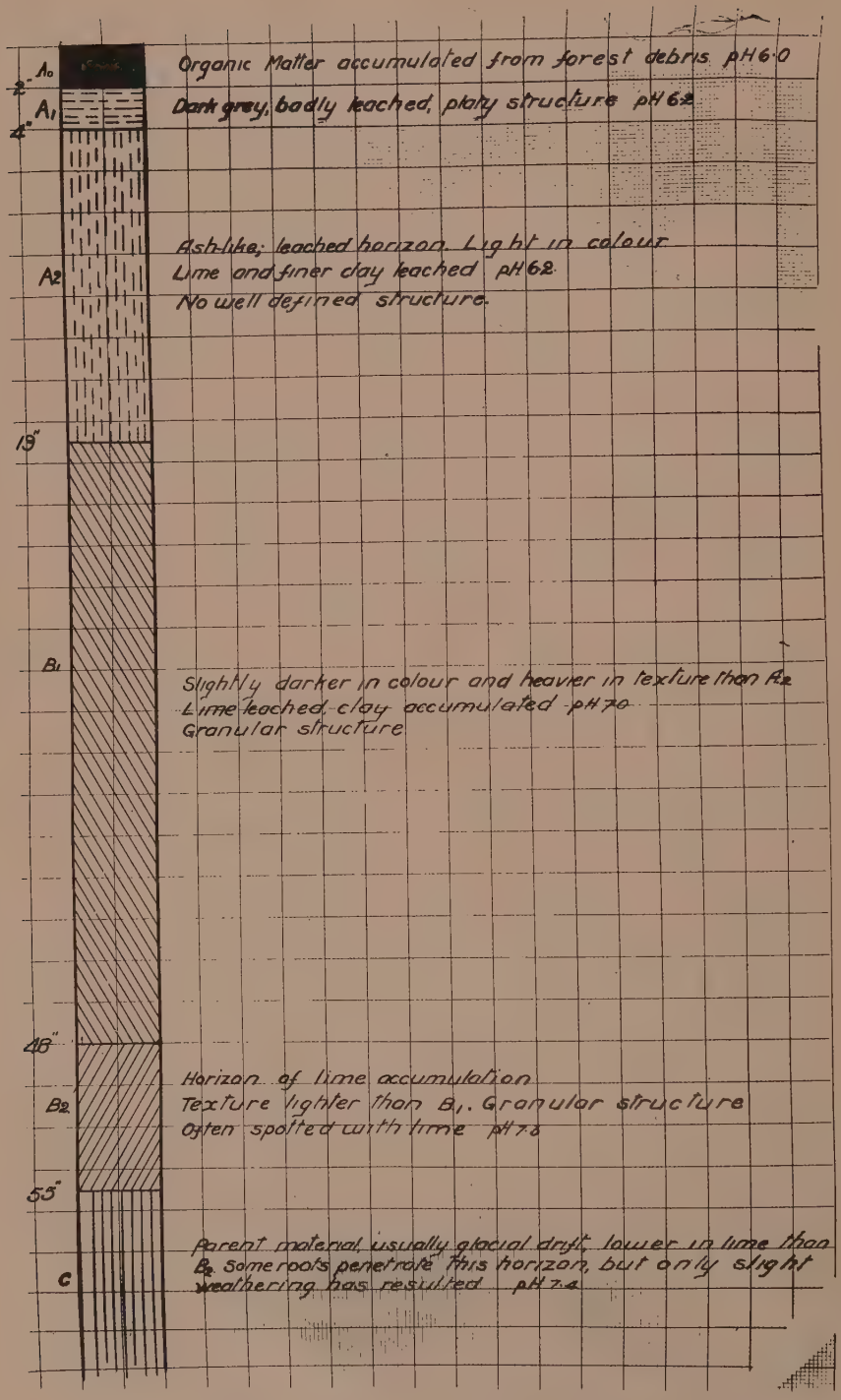
A0
Organic Matter accumulated from forest debris. pH 6·0
2"
A1
Dark grey, badly leached, platy structure pH 6·2
4"
Ash-like; leached horizon. Light in colour
A2
Lime and finer clay leached pH 6·2
No well defined structure.
13"
B1
Slightly darker in colour and heavier in texture than A2
Lime leached, clay accumulated pH 7·0
Granular structure
48"
Horizon of lime accumulation
B2
Texture lighter than B1. Granular structure
Often spotted with lime pH 7·8
55"
Parent material, usually glacial drift, lower in lime than
B2 Some roots penetrate this horizon, but only slight
C
weathering has resulted pH 7·4

FIGURE 1. Diagram of profile from typical wooded soil, (Alberta).

TABLE 1. *Composition of typical wooded and typical black soils of Alberta.*

Horizon	Depth in inches	Per cent. N	P	Ca	Mg	$CaCO_3$	pH
Wooded Soil							
A_0	0-2	.49	.09	1.18	.35	—	6.0
A_1	2-4	.09	.06	.55	.33	—	6.2
A_2	4-19	.03	.03	.61	.56	—	6.2
B_1	19-48	.04	.03	.56	.45	—	7.0
B_2	48-55	.02	.04	2.68	.84	7.67	7.3
C	55-	.03	.05	1.96	.76	4.11	7.4
Black Soil							
A_1	0-12	.53	.10	.94	.50	—	6.0
A_2	12-16	.11	.05	.65	.64	—	6.4
B_1	16-30	.06	.04	.71	.69	—	6.8
B_2	34-40	.04	.05	3.11	.76	7.04	7.6
C	40-	.04	.05	1.38	.75	3.06	7.6

The differences in the chemical composition of the various horizons of the typical wooded soil profile are shown in Table 1. This table also contains similar data for a typical profile from the black soils. It will be seen that the upper 2 inches of the wooded soil is almost identical in composition with the upper 12 inches of the black soil. In the first case, the horizon consists chiefly of organic matter whereas the corresponding horizon in the black soil is characteristically mineral in nature and contains a large amount of organic matter (grass roots) intimately mixed with the soil. The A_2 horizon in the black soil occurs at a greater depth than in the wooded soil and also contains more nitrogen and phosphorus. On the other hand the B_2 (lime layer) is encountered at a depth of only 34 inches in the black soil and at 48 inches in the wooded soil. This indicates severer leaching in the wooded soil than in the black soil. Except for the upper 4 inches (A_0 and A_1) the wooded soil is rather low in phosphorus and nitrogen. In fact the nitrogen and phosphorus content of the wooded soil at a depth of from 5 inches downward is about the same as that in the black soil at a depth of from 34 inches downward.

The differences in depth and composition of the corresponding horizons for these two soils is brought out more clearly in Table 2 where the total amounts of the various constituents have been computed for each of the upper 3 feet. An inspection of Table 2 shows that the greatest difference in composition between these two soils occurs in the first foot, where it will be seen that the black soil contains six times as much nitrogen and more than twice as much phosphorus as the wooded soil. There is likewise more nitrogen and phosphorus respectively in the second and third foot depths of the black soil than is found in the corresponding depths for the wooded soil. The totals for the upper 3 feet bring out the following relationship:

about four times as much nitrogen, twice as much phosphorus, twice as much calcium, and more magnesium in the black soil than in the wooded soil. Appreciable quantities of calcium carbonate are likewise found in the third foot of the black soil, whereas carbonates are not encountered in the wooded soil nearer the surface than the fifth foot.

TABLE 2. *Total plant foods in upper three feet of typical wooded and typical black soils of Alberta... (pounds per acre).*

Depth	N	P	Ca	Mg	$CaCO_3$
Wooded Soil					
1st foot	3,082	1,557	20,794	14,675	———
2nd "	1,200	1,050	20,600	17,950	———
3rd "	1,400	1,050	19,600	15,750	———
Total	5,682	3,657	60,994	48,375	———
Black Soil					
1st foot	18,500	3,500	32,900	17,500	———
2nd "	3,232	1,766	27,400	26,767	———
3rd "	1,750	1,575	66,850	25,370	123,200
Total	23,482	6,841	127,150	69,637	123,200

The above comparisons show that the wooded soil contains much smaller quantities of plant foods than are found in the black soil, and it may be presumed that the wooded soil is decidedly deficient in plant foods. However, it should be stated that the analysis of the wooded soil as shown by the data in the above tables would indicate that it compares favorably with a great many of the world's fertile soils; and from the analysis alone one would be at a loss to explain the reason why such a soil would not give satisfactory crop returns. The fact still remains that the poorer phases of our wooded soil in most cases show unsatisfactory crop returns.

The better phases of the wooded soils—those intermediate between the typical black and the typical wooded soils—usually give satisfactory crop yields, whereas the poorer phases usually give yields which are somewhat disappointing. This is especially so during an unfavorable season and often entire crop failures are experienced from the wooded soils whereas average yields are returned from the black soils.

The conditions thus revealed by farming practices on these wooded areas led us to outline experiments in an attempt to explain these differences and if possible to find a remedy. The results of these experiments are outlined below.

EXPERIMENTAL

Originally the soil used in the following experiments had supported a fairly heavy tree growth, consisting chiefly of poplar, willows, and native shrubs together with long grasses, and some native legumes.

The soil was collected July 5th, 1925, from an area which had just been broken the previous season and was seeded for the first time to oats which were about 4 inches high, showing an irregular stand. The breaking had been done to a depth of 5 or 6 inches, and some of the light coloured A_2 layer had been turned up. About ½ ton of soil for experimental purposes was taken to the depth of breaking (5 to 6 inches) and consisted of the A_0, A_1 and the upper inch of A_2 horizons. These horizons were not separated for analysis, but a composite sample showed the following results: Nitrogen .114, Phosphorus .036, Calcium .43, Magnesium .35 per cent respectively with a pH of 6.5. This soil represents the poorer phase of the wooded soils and may be considered as in its virgin condition since it had grown no cultivated crops. In texture this soil is silt loam and when moist is easily cultivated, but upon drying it packs and becomes very difficult to till. This is characteristic of the greater part of the wooded soils of Alberta.

The soil was air-dried and thoroughly mixed and 8 pounds weighed into each of 87 glazed earthenware jars of 1 gallon capacity. These were divided into three series and treated as follows:

Jar No.	Treatment
1—6	Nothing.
7—9	Farm Manure, 30 tons per acre.
10—12	Nitrogen ($NaNO_3$), 500 lbs. per acre.
13—15	Lime ($CaCO_3$), 5 tons per acre.
16—18	Phosphorus (acid phosphate), 2 tons per acre.
19—24	Lime and phosphorus, 5 and 2 tons per acre respectively.
25—27	Mixed fertilizers (3:10:7), 1 ton per acre.
28—30	Potassium (K_2SO_4), 400 lbs. per acre.
31—33	Sulphur, 200 lbs. per acre.

Series 1 and 2 consisted of 27 jars each with fertilizer treatment in triplicate, excepting in the case of the lime and phosphorus jars and again in the case of the controls. In both of these instances there were 6 jars instead of 3. Series 3 contained 33 jars, the first 27 being treated as in series 1 and 2 and, in addition, 3 jars receiving K_2SO_4 and 3 receiving sulphur.

Series 1 produced barley in 1925, sweet clover in 1926, wheat in 1927 and oats in 1928. Fertilizers were applied to this series in 1925 and again in 1927.

Series 2 produced sweet clover, wheat, barley, and wheat in the above order with the fertilizers applied to the sweet clover and barley crops.

Series 3 produced barley, sweet clover (failed to germinate), and red clover. Fertilizers were applied to the barley and red clover crops.

During the four years, 1925 to 1928, the following crops were grown: 3 crops barley, 2 crops sweet clover, 3 crops wheat, 1 crop oats and 1 crop red clover. The relative yields computed on the basis of 100 for the controls (average of 6 jars) are reported in Table 3.

TABLE 3. *Crop yields as affected by fertilizers applied to wooded soils (Alberta). Results as relative yields where average of checks equals 100.*

Series	Fertilizers Applied	Crop	Fertilizer Treatments. None	Manure	Nitrogen	Lime	Phosphorus	Lime and Phosphorus	Mixed Fertilizer	Potash	Sulphur
1	1925	Barley grain	100	75	26	113	123	160	165		
		" straw	100	61	154	123	133	138	211		
2	1925	Sweet Clover	100	83	125	100	122	130	135		
1		Sweet Clover	100	113	105	119	127	147	106		
2		Wheat grain	Grain destroyed by birds July 24th. Straw harvested Aug. 6th.								
		" straw	100	133	115	117	114	137	129		
3	1926	Barley grain	100	121	112	119	138	133	85	103	102
		" straw	100	140	121	110	136	163	163	85	86
1	1927	Wheat grain	100	116	121	151	164	164	141		
		" straw	100	111	150	170	193	188	203		
2	1927	Barley grain	100	114	160	161	145	149	182		
		" straw	100	87	151	155	144	138	278		
3		Sweet Clover	Failed to germinate.								
1		Oats grain	100	144	86	122	102	112	103		
		" straw	100	201	104	127	121	148	118		
2		Wheat grain	100	134	100	111	112	111	106		
		" straw	100	171	102	108	126	128	108		
3	1928	Red Clover	100	556	132	164	449	488	370	109	100
		Averages	100	147	116	129	153	165	163	99	96

After seeding, the jars were kept at optimum moisture in the greenhouse until considerable growth had taken place. They were then placed out in the open until maturity. The natural rain water was supplemented with distilled water whenever necessary throughout the entire growing period of the plants.

The following general observations were noted regarding the appearance of the plants grown with the different fertilizer treatments:

(1) Seeds germinated more rapidly where phosphorus in any form had been applied.

(2) Growth of plants was most vigorous and rapid where phosphorus had been applied.

(3) Plants matured more rapidly in case of phosphorus applications—grain crops and legumes blossomed from 1 to 2 weeks earlier for the jars receiving phosphorus.

(4) The total produce, as indicated by final yields, was greatest for the treatments carrying phosphorus.

An inspection of the averages of all crops in Table 3 (see also Figure 2A) shows that the greatest responses in crop yields were experienced wherever phosphorus was added; that is, phosphorus alone, phosphorus and

lime, mixed fertilizer or manure. In the case of the mixed fertilizer treatment the increases in crop yields were caused largely by the phosphorus rather than by the potash or nitrogen, since nitrogen alone gave but small increases and potash alone gave yields identical with the controls.

General averages for all the crops grown showed increases for the various fertilizer treatments as follows: nitrogen 16, lime 29, manure 47,

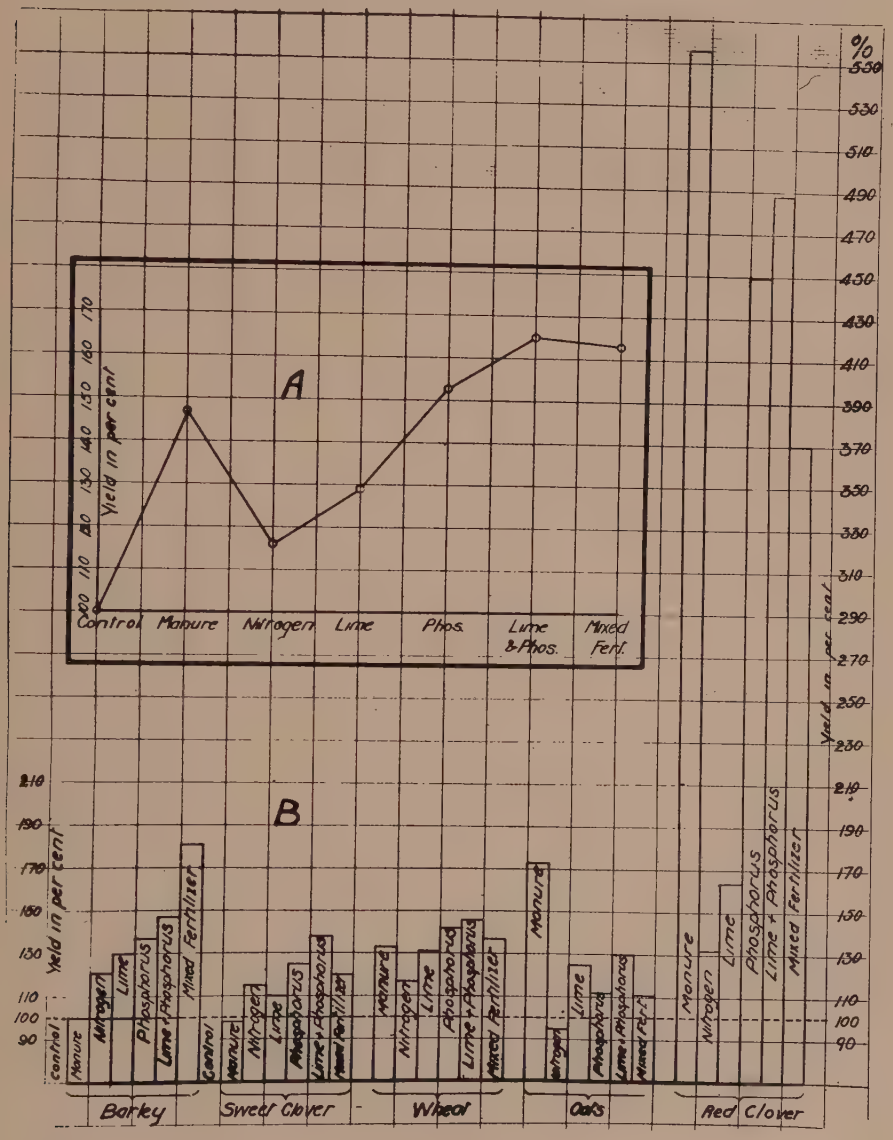

FIGURE 2.

A. Average increased yields (per cent.) for five crops with various fertilizers applied to wooded soils.

B. Individual differences in yields of five crops with various fertilizers applied to wooded soil, (Alberta).

phosphorus 53, mixed fertilizer 63, lime and phosphorus 65 per cent, respectively. The potassium and sulphur treatments gave yields identical with the controls and for this reason have been omitted from the table and graphs.

For each of the legume crops grown, 3 of the control jars and 3 of the lime and phosphorus jars were inoculated and 3 jars in each of the above treatments were left uninoculated. There were no appreciable differences in the yields from the inoculated and uninoculated jars. Nodules were found on the roots of all legume plants.

It should be stated that even though this soil was slightly acid no difficulty was experienced in getting legumes to produce fair crops without the application of lime after such crops had become established. However, the application of lime gave appreciable increases in yield for all the crops grown.

Under field conditions the farmer often experiences difficulty in getting a satisfactory stand of the legume crops on the wooded soils owing largely to the undesirable physical condition of the soil. This is due to the great tendency of the wooded soils to bake when they become dry. The difficulty above mentioned can largely be overcome by the generous application of farm manure. The authors have seen very good stands of sweet clover, alfalfa, red clover and alsike clovers growing on the wooded soils but almost invariably such desirable results have accompanied or followed the use of farm manures.

Since no great increase in yields was shown from the application of nitrogen it was suggested that nitrification proceeded in this wooded soil at a rate sufficient to meet the demands of the growing crops. The virgin soil contained 10 p.p.m. of nitrate nitrogen when it was first weighed into the jars. After the crops were harvested samples of the soil were drawn and nitrates determined. The soil was cultivated and brought up to optimum moisture content and then left 38 days when samples were again drawn and nitrates determined. Table 4 shows the relative rates of nitrification for the various treatments.

TABLE 4. *Effect of different fertilizers upon nitrate production in wooded soil and nitrogen removed by crops.*

Treatment	Nitrate Nitrogen in soil p.p.m.*		Nitrogen removed in crops.				
			Sweet Clover		Barley		
	Mar. 12	Apr. 19	%N. in crop	Mgs. N crop	% N. in grain	% N. in straw	Mgs. N in crop
None	2.0	57.5	2.99	227.5	2.25	.54	90.8
Manure	5.4	62.0	2.82	243.4	1.78	.39	50.9
Lime	3.4	61.1	2.78	244.7	2.38	.53	109.0
Phosphorus	trace	22.2	1.91	184.5	1.89	.46	95.8
Lime and Phosphorus	trace	56.5	2.19	245.7	1.90	.49	123.2
Nitrogen	80.4	190.4	3.64	290.1	3.90	3.32	218.5
Mixed Fertilizers	trace	56.7	2.66	214.7	2.27	.73	225.9

*The sweet clover was harvested March 12. Samples of soil were immediately taken for nitrate determinations. The soil was then cultivated and brought up to optimum moisture content and left until April 19, when it was again sampled for nitrate determinations.

By comparing columns 2 and 3 it is seen that in general nitrification was vigorous following the growth of sweet clover, but that the jars treated with phosphorus alone showed a depression in the production of nitrates. The remainder of the table (columns 4 to 8 inclusive) shows the nitrogen content of sweet clover and barley crops together with the total amount of nitrogen removed from each jar by these crops. In this connection it is interesting to note that whereas the application of phosphorus depressed nitrification, the nitrogen content of the crops was lower accompanying the phosphorus treatment, but the crop yields were actually increased. (See Table 3). This indicates that nitrogen is not a limiting factor in this wooded soil to the extent that phosphorus or even lime is. Attention might also be drawn to the extremely high nitrogen content of both the barley and sweet clover where nitrogen alone had been applied. This treatment yielded crops with about twice as much nitrogen per unit weight of crop as had the phosphorus treatment.

A better idea of the effect of various fertilizer treatments upon the rate of nitrate production may be had by comparing the data obtained in another experiment where the virgin wooded soil was treated in a similar manner to the soil used in the jar experiments. Here soil was weighed into tumblers and incubated in the laboratory for approximately two months. Nitrates were determined at the end of the first month and again at the end of the second month. These results are given in Table 5.

TABLE 5. *Nitrate production in virgin wooded soil as influenced by different fertilizers.**

Treatment	Nitrate nitrogen in soil (p.p.m.)	
	Incubated for 32 days	Incubated for 62 days
None	24.5	55.9
Manure	17.2	28.0
Lime	69.6	89.2
Phosphorus	20.0	24.0
Lime and Phosphorus	52.1	78.7
Mixed fertilizers	24.9	41.3
Dried blood	266.0	387.9
Dried blood and soil infusion	350.4	385.3

*At the beginning of this experiment the soil contained 10 p.p.m. of nitrate nitrogen.

The data in Table 5 show that the wooded virgin soil has an inherent power to support a fairly vigorous nitrification. The application of lime ($CaCO_3$) stimulated nitrification (about 25 against 70 p.p.m. at the end of 32 days and 56 against 89 at the end of 62 days) whereas the application of phosphorus retarded nitrification (about 20 against 25 p.p.m. at the end of 32 days and 24 against 56 at the end of 62 days). A treatment of lime plus phosphorus showed less nitrates at both periods than did lime alone. Where readily nitrifiable organic matter such as dried blood was applied, nitrification was from six to ten times as rapid as in the controls. An addition of nitrifying organisms (soil infusion) had some effect during the first 32 days of incubation, but this advantage had disappeared at the

end of 62 days. This again shows that the virgin soil was well supplied with these organisms.

Summary

1. The wooded soils of Alberta occupy approximately two-thirds of the entire area of the province. A similar belt of soil extends across Saskatchewan and Manitoba. Within the wooded soil belt are to be found soils varying in all degrees between a typical parkland soil and a typical wooded soil. The better phases of the wooded soils—those intermediate between the typical black and the typical wooded soils—usually give satisfactory crop yields, whereas the poorer phases usually give yields which are somewhat disappointing. This is especially so during an unfavorable season and often entire crop failures are experienced from the wooded soils, whereas average yields are returned from the black soils.

2. The typical wooded soil of Alberta is briefly described and its composition discussed. When plowed this soil is ashlike in appearance due to the turning up of a part of the A_2 horizon. The lime layer B_2 is encountered at a depth of from 4 to 6 feet in the wooded soil. This is about 1 to 2 feet deeper than in the black soil and 2 to 3 feet deeper than in the brown soil. The pH values for the A_0 to B_1 horizons in the wooded soil vary from 6.0 to 6.8. However, they are lower in general than for the black soil.

It is shown that the mineral plant foods are less abundant in the wooded soils than in the black or brown soils. The first foot of the black soil contains six times as much nitrogen, twice as much calcium and more magnesium than is found in the same depth of the wooded soil.

3. Virgin soil from the poorer phases of the wooded areas was used in jar experiments. Various fertilizers were applied at different intervals over a period of 4 years and the following crops grown: barley, sweet clover, wheat, oats and red clover. The following general observations were noted:

(a) Seeds germinated more rapidly where phosphorus in any form had been applied.

(b) Growth of plants was most vigorous and rapid where phosphorus had been applied.

(c) Plants matured more rapidly in case of phosphorus applications—grain crops and legumes blossomed from one to two weeks earlier for the jars receiving phosphorus.

(d) The total produce, as indicated by final yields, was greatest for the treatments carrying phosphorus.

General averages for all the crops grown showed increases for the various fertilizer treatments as follows: nitrogen 16, lime 29, manure 47, phosphorus 53, mixed fertilizer 63, lime and phosphorus 65 per cent, respectively.

4. Other experiments showed that the virgin wooded soil had the inherent power to support a fairly vigorous nitrification. The application

of lime ($CaCo_3$) stimulated nitrification, whereas the application of phosphorus retarded nitrification. The treatment of lime plus phosphorus showed less nitrates than did lime alone. In this connection it is interesting to note that while the application of phosphorus depressed nitrification and the nitrogen content of the crops was lower accompanying the phosphorus treatment, the crop yields were actually increased, due to the phosphorus treatment. This indicates that nitrogen is not a limiting factor in this virgin wooded soil to the extent that phosphorus or even lime is.

5. The results obtained from the experiments reported in this paper seem to indicate that it would not only be profitable to apply such fertilizers as phosphorus, lime or marl, and farm manures to certain areas of our wooded soils, but that this practice, together with the use of some legume crop in the rotation, would be absolutely necessary if satisfactory crop yields are to be obtained.

THE DEVELOPMENT AND PRESENT STATUS OF FORAGE CROP CULTURE IN CENTRAL EUROPE*

A. VOLKART†

Pure science knows no boundary lines. Its established principles hold good anywhere, under any conditions. On the other hand the applied sciences, and particularly our common task, the application of science to agriculture, bind us closely to the country for which we work. This has its great advantages, not least of which is the fact that the direct utility value of our work is much more evident than for the worker in pure science, thus giving us the certainty that we are rendering good service to our country. But it also has its drawbacks, in that we are forced to adapt our work so closely to the soil, the climate and the economic conditions, that the results of our work seem to have importance for our own country only.

I became especially aware of this weakness of our work when your Society honoured me with an invitation to give you an account of my research work in forage culture. It seemed impossible for me to give you results of experiments which could be of immediate benefit to you. But for the fact that I have myself profited a great deal from research work done on this continent, I should have hesitated to accept your invitation. Many a question which seemed impossible of solution by only considering the conditions of my country became clear to me through the results of research work carried out abroad So I may hope that an account of our own experiments will be of some value to you.

In our own work it is impossible to benefit from the results of foreign experiments without taking into account climatic and soil conditions. I am obliged, therefore, to give you first a short account of these fundamental conditions as affecting forage crop culture in the territory of which I am to speak, namely Switzerland, Southern Germany and the Austrian Highlands.

Generally speaking the whole of this area shows a high annual precipitation, reaching as high as 80 inches and over in the Alpine districts, while most of the country has 40-50 inches. There are some valleys in the Alps and the plain below Bale where rainfall goes below 24 inches. The average monthly rainfall on the Swiss plateau corresponds with that of the eastern provinces of Canada, the maximum falling in mid-summer. Berne and Zurich have the highest precipitation in June and August, Geneva in October, the latter thus showing conditions nearing those of the Mediterranean. A marked summer drought as occurring in British Columbia is very exceptional in Switzerland. (See Figure 1).

The mean annual temperature in Switzerland corresponds roughly with the average between that of the Canadian Pacific coast and the provinces east of the Rocky Mountains. For the purpose of comparison Figure 2 shows the respective mean temperatures from month to month of some representative localities in Canada and Switzerland. It will be observed

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that in Zurich and Berne the monthly average falls below freezing point only in December and January, and this only by 1-2°. A snow cover of long duration is very rare. Further, it is of importance to forage culture that spring sets in slowly. The temperature does not rise so quickly in Switzerland during spring as it does in either Winnipeg or Fredericton.

The soil is mostly a mild loam; sandy soils are rare, and heavy clays are mostly found in the subsoil. Silt or loess soils also are not very frequent.

In classifying our soils according to physical properties we use Kopetzky's apparatus, which establishes the following four fractions:

	DIAMETER OF PARTICLES
Coarse Sand	0.1 — 2 mm.
Fine Sand	0.05 — 0.1 mm.
Silt	0.01 — 0.05 mm.
Clay	0.01 mm.

Soils containing more than 50 per cent of the finest particles are called clay, those with more than 50 per cent of the second fraction silt. When there is more than 50 per cent of fine and coarse sand together, we have sandy soils, and if neither clay nor silt nor sand reaches 50 per cent we have a loam. The graph in Figure 3 illustrates how intermediate types are established. For instance, if we have a soil with 30 per cent clay and 30 per cent silt the two corresponding lines are followed until they meet and the resulting soil is seen to be a silty clay. The graph on the right of Figure 3 shows the results of 480 physical analyses of Swiss soils made during the last three years. Each point represents one determination. It is easy to read from this graph that clayey soils predominate by far, with sandy loams second in frequency, then clayey sand and silty sand, while true clay, sand and silt soils are rarely found.

The determination of the hydrogen-ion concentration of the soils is made by means of the quinhydron-electrode in a suspension of the soil in water. The results of 2419 determinations are shown in Figure 4. 1679, or 69 per cent of these soils are alkaline, i.e., with a pH value of over 7. The great ice sheets which covered most of the country during the pleistocene period left calcareous material on the myocenic molasses nearly everywhere.

It is evident from these few notes that, on the whole, soil and climate in Central Europe, especially in Switzerland, are very favourable to forage culture. Field crops, on the other hand, are at a disadvantage. The abundant summer precipitation and the rather heavy soil hinder the tillage. The wet climate favours strong development of straw in cereals, with consequent damage from lodging.

Besides climate and soil the conditions of first colonisation and the primitive field systems, which are closely allied, were of great importance for the development of forage culture. The peoples who invaded Southern Germany, Switzerland and Austria, driving back the Celtic inhabitants, first took possession of the land already cultivated or only slightly wooded. In most cases this land was situated along rivers, where comparatively light and dry soils more suited for cultivation are prevalent. The densely wooded districts with heavy soils remained unoccupied for a long time.

The first invaders built their houses closely together in order to protect each other. They founded villages. For each village three fields were set apart. The first was seeded to a winter cereal, the second to a summer cereal, and the third was left in fallow. This is the three field system. Each of the two cornfields was cultivated conjointly by the inhabitants of the village. Later on each family received a strip of land in each field and if the field was enlarged each received another strip in the new part. Afterwards these strips were divided lengthwise by inheritance in two, four and more allotments. The fields of a family, therefore, were not contiguous but intermingled with those of other families, each family thus possessing 30, 50, and even 70 and more, long narrow strips of land strewn all over the whole acreage of the village. In this way originated the so-called mixed position of the plots illustrated in Figure 5.

The three fields were cultivated uniformly for a long time. In the second half of the eighteenth century the farmers began to plant red clover and potatoes in the third year in the place of fallowing. The rotation, however, was kept up strictly. Therefore red clover, which was sown in the summer cereal as a cover crop, could only be used in the year after sowing. In autumn of that year it had to be ploughed in order that winter corn could be sown. This is the way the so-called "Ackerklee" originated, a red clover which can only be used one year. If not ploughed down it disappears mostly in the second winter. The yield of this clover in the year after sowing is very considerable, amounting on the average of numerous experiments to 11.3 tons of hay to the hectar (90 cwts. to the acre). Experiments in southern Germany, as well as with us, proved this red clover to be the earliest of all known varieties. It of course suffers acutely from late frosts in the spring and would scarcely do well in Canada.

Later on, as soon as every single plot in a field could be reached throughout summer by pathways inserted between the divisions of a field, the uniform cultivation of a field ceased. Every farmer grows nowadays whatever he wants; that is why the fields of a village present now so checkered an aspect as illustrated in Figure 5. Nevertheless many farmers retain the rotations of the improved three field system. They grow wheat the first year, in the second year winter rye (which was substituted for the summer cereal, viz. oats or barley), in the third year potatoes, in the fourth wheat, in the fifth rye as a cover crop for red clover to be used in the sixth year.

There are even villages which still adhere to the uniform croppings of all plots of one field. We can therefore see this very day in some rare village the three entire fields, one seeded to wheat, the second to rye and the third to clover and potatoes.

Of course there are a great many exceptions to this rotation, and adaptations to the changed conditions. It must especially be noted that the second field system, of which I am now going to speak, penetrates slowly but irresistibly into the three field system. As I mentioned before, the districts with rather light, dry soil not densely covered with forest were first occupied by village dwellers who originated the three field system.

Where the soil was heavy, rather wet, and in consequence thickly wooded, especially in the hilly regions and in the narrow side valleys of the rivers, settlement was long delayed. In these unclaimed districts monasteries were founded during christianization, but soon the feudal sovereigns of the country laid their hands upon this land and colonized it for the increase of their income and for the strengthening of their military forces. The legal protection of the inhabitants was now greater; it was no longer necessary to live together in villages. Single farms were established. Each farmer in these districts had his land enclosed round his house. Nearest the farmstead there is the orchard, then permanent meadows which are cut for hay or green fodder, further on pasture land and beyond it the forest. The pasture land formerly was divided into 6-9 parcels. Each year one of them was ploughed in the beginning of summer. It was fallowed during the summer and sown with a cereal, mostly spelt, in autumn. Following spelt oats were sown in the spring and after the harvesting of this crop the land was left and soon, without any seeding, covered itself with natural grasses and was used for 3 to 6 years for pasture again. This is the system referred to as "Egartenwirtschaft" or alternate husbandry. It is somewhat similar to the Celtic system as used in the outer field of primitive Scottish agriculture and was widely practiced in southern Germany, Switzerland and Austria, where it is still to be met in its original form. (Figure 6).

Out of this Egartenwirtschaft developed the true alternate husbandry or grass-clover system. With the progress of agriculture in the second half of the eighteenth Century the rotation in these districts became irregular. The field was now often ploughed in the winter or in the spring and sown to oats. In the second year it was cropped with rye, following this with potatoes and then spelt. Into the spelt were sown seeds not only of red clover but also of grasses. These grass-clover mixtures were cropped for hay during 3 to 6 years. Thus in these districts early development of the sowing of grass and clover mixture took place. This practice will be referred to later.

The red clover which was used here was originally the same as in the districts of the three field system. It was the red clover called "clover of Brabant", because its culture was introduced into this part of Europe from the Netherlands. In these districts, with alternate husbandry, it remained longer on the field than in the three field system. The fields were allowed to ripen for seed mostly in the third and fourth year. Thus a selection in the line of a longer duration took place apparently furthered by spontaneous crossings with the wild red clover of the permanent meadows (*Trifolium pratense spontaneum*). In this way there resulted a perennial form of red clover, the so-called "Mattenklee", eminently fitted to be sown in these mixtures. This also is an early flowering red clover. We do not know late flowering varieties in the whole territory under review.

Agriculture took a very different development during the nineteenth century in the different countries of the territory in question. Germany and Austria protected their agriculture, especially cereal growing; in Switzer-

land no tariff protection was afforded. Consequently the cultivation of grains, roots and other field plants diminished in Switzerland as soon as the railways brought wheat and other cereals at a low price into the country. Cattle breeding and dairy farming developed in connection with this forage production. It is well known that with grain, roots and other products of field culture more plant food disappears from the soil than on livestock farms. This holds good with nitrogen and potash while on the other hand phosphoric acid is taken away in a greater proportion. The stock of nitrogen and potash in a farm increases especially when a great amount of commercial feeding-stuffs is used. The meadows receive more manure, especially the permanent meadows in the neighbourhood of the farmyard. In Switzerland as well as in Southern Bavaria and Austria these permanent meadows are very heavily fertilized with liquid manure. Very often this is applied after each cutting, so that on an average 11,000 to 13,000, and in some cases as much as 27,000, gallons are applied per acre and season, in 4 to 5 applications. In this way the meadows are provided with abundant quantities of plant food. According to our determinations the amount with moderate manuring is 35 lbs. of phosphoric acid, 107 lbs. of nitrogen, and 225 lbs. of potash to the acre. Often the quantity of plant food goes as high as 120 lbs. of phosphoric acid, 268 lbs. of nitrogen, and 625 lbs. of potash. These high dressings correspond with high withdrawals of plant food. Up to 110 to 115 cwts. of hay per acre are harvested and for the production of this quantity the plants withdraw from the soil 62.5 lbs. of phosphoric acid, 180 lbs. of nitrogen and 285 lbs. of potash. The grass is often used for soiling, and in this manner the biggest yield is derived from the land. Equally often the meadows are used as pastures in order to save manual labour. The quantity of forage gained is then not so large, the quality in return better. After each grazing liquid manure is spread over the pasture.

As a consequence of this system of manuring, the soil is saturated with potash but remains deficient in phosphoric acid. We found the proportion of phosphoric acid and potash in the hay to be a reliable index for the judging of deficiencies of these substances in the soil. As the result of a great number of fertilizer experiments we found that if the contents of the grass exceed 0.8 per cent phosphoric acid in the dry matter, there is no need for phosphoric fertilizers; if it is below 0.6 per cent there is great need for it, while the corresponding figures for potash are 2.5 and 2.0 per cent.

When the contents are medium (0.6—0.8 phosphoric acid, 2.0—2.5 per cent potash) we recommend applying as much phosphoric acid or potash as the forage withdraws from the soil; if it is lower a strong dressing is to be given. Each year a great number of analyses in this direction are made and we find that a great many of our meadows are deficient in phosphoric acid, but there are few which need potash. (Figure 7).

The rich manuring of the meadows has partly undesirable effects. Nitrogen, in the form of ammonia, and potash drive the lime from the

soil-particles in the soil solution by base-exchange whence it is lost in the sub-soil. In the long run the soil becomes deficient in lime but contains an excess of potash, so much so that sometimes we find as much as 6 to 7 per cent of potash in the dry matter of the hay. This is too high a proportion to make such hay a desirable food for livestock. Fortunately our soils are originally rich in lime so that bad effects are rarely apparent A noticeable effect, however, is an undesirable change in the botanical composition of the meadows. The unbelliferous plants increase. In the first cutting wild beaked parsley (*Anthriscus silvestris*) is so prevalent that the meadows are snowy white. (Figure 8). In the second cutting common cow parsnip or hog weed (*Heracleum sphondylium*) spreads its inflorescenses like umbrellas over the small grasses and other plants of the meadow.

If such grass is used for soiling the contents of the milk in fat and dry matter are appreciably lowered. If on the other hand the meadow is left for making hay these plants become tough as wood; the hay contains an excess of fibre. The fight against this class of weeds presents a rather interesting problem. Many agronomists maintain that their increase in the meadows is the consequence of one-sided manuring, i.e., application of an excess of nitrogen and potash and insufficient phosphoric acid. Liquid manure contains on the average only 0.3 per cent phosphoric acid, but 2 per cent nitrogen and 5.3 per cent potash. Actual analyses, however, showed that the lack of phosphoric acid is not so great as might be expected. The soil bearing this type of meadow contains a remarkable stock of available phosphoric acid. Therefore it is not possible to reduce these weeds by strong dressings of phosphoric acid. The same holds true with regard to lime. As a rule we find sufficient lime, ranging from 0.4 to 30.0 per cent of carbonate of lime, on an average 8.5 per cent. Consequently the pH value goes below 7.0 in very rare cases only. It may drop as low as 6.4 but reaches 7.7 occasionally and averages about 7.3. In looking for effective means for controlling these undesirable plants we have to resort to pasturing in the spring rather than the corrective application of fertilizers.

Similar questions arise frequently in the management of our meadows. In order to get a good foundation for the solution of these questions we have begun to examine the soil of each formation as closely as possible. In this way we hope to find hints as to how weeds of our meadows can be fought and substituted by desirable plants. It should be possible to derive from the botanical composition of a meadow the nature of the soil, texture and structure, reaction, and reserves of phosphoric acid, nitrogen and potash as well as the annual yield and the feeding value of the hay. The need of the different nutritious substances for the plants should thus be ascertained from the botanical composition of the meadow. Considerable work has already been done in this direction. Figures 9 to 14 show the results of the examination of the soils of five quite prevalent types of meadows. In each case the results of physical analyses of the soils are shown by the triangle method previously described, and in addition the percentages of available phosphoric acid and potash as established by the seedling method of Neubauer, and the percentage of carbonate of lime.

These latter data are compared in each case with those of the soils of the five other typical formations.

These examinations are incomplete. It will be noticed that we have no data regarding nitrogen. It is impossible to determine the amount of nitrates formed in a soil by the seedling method of Neubauer. Experiments have now been planned which will fill this gap.

Let me now come back to the alternate husbandry. I have shown in the brief historical sketch how we came to the practice of sowing grass and clover mixtures to last not only for 2 to 3 but for 3 to 6 years. The merit of having essentially furthered the establishing of grass and clover mixtures on a scientific basis belongs to Dr. F. C. Stebler, who in 1876 established the first seed testing station of Switzerland and laid the foundation for his subsequent experimental work in forage culture, the results of which are known the world over. He popularized his work by giving numerous courses among farmers, but particularly by publishing his book "The Best Forage Plants", a manual with good illustrations. Dr. Stebler was for Switzerland what P. Nielsen, farm hand, school-master, and founder of the first Danish Experimental Station in Tystofte, was for Denmark. He tried very early to determine the cultural value of grass and clover seeds of different origin. In his research work Dr. Stebler was largely supported by Dr. Carl Schröter, professor of botany at the Swiss Polytechnic School in Zurich, who investigated particularly the ecology of forage plants and the composition of the natural meadows of Switzerland.

Of greatest assistance to the practical farmers was the "Seed Table" published by Dr. Stebler as a guide in the compounding of mixtures. This table shows the average purity and germination of the different kinds of forage plant seeds, and the quantity of seed required to the hectar under different conditions of soil, altitude, climate, and according to whether the seed is to be sown in pure culture or in mixtures. Thus the farmer can read directly, after having decided on the kinds to be included in the mixture, the amount of each kind of seed to the hectar recommended for his condition. This table is widely in use. In addition Dr. Stebler introduced a second method for calculating mixtures on the basis of the so-called "kilogram percentages", where the quality of the seed is also taken into consideration. This method is used in experimental work only, where special care in the adjûstment of seed quantities is required.

The first method is widely used by progressive farmers, most of whom do not buy mixtures according to prescriptions. They observe their fields closely, note which kinds of clovers and grasses develop well, and which of those sown do not appear to be able to hold their own, and then compound their mixtures accordingly. This is only possible because most farmers are intimately acquainted with the principal clovers and grasses through courses and publications such as the book "The Best Forage Plants". In addition specimen collections are sold at very moderate prices.

Farmers' co-operatives play an important rôle in supplying high-quality seeds, particularly seeds of known origin suitable for our climate. The seed testing station at Zurich did not confine its work to the testing of purity and

germination; as stated before, Dr. Stebler was among the first in Europe, if not the first, to establish by accurate experiments the cultural value of seeds of different origins. From 1880 to 1928 nearly 200 experiments along these lines, with from 500 to 600 different classes of seeds, were carried out. The results of this work may be briefly summarized as follows:

1. Seed grown in the country and derived from old autochthonous varieties is best. The plants of such varieties give the largest yield and have the longest life.

2. Varieties from the south generally are not well adapted. Their hardiness in the winter is not sufficient, and they are subject to various diseases. Red Clover from Italy, for instance, as a rule is badly infested by stem-rot (*Gloeosporium caulivorum*). However, there are exceptions. Alfalfa from southern France and from Italy stood the test in Switzerland, while farther to the north they are no more suitable. The Scandinavian and Baltic States prefer Hungarian Alfalfa. Red clover from central and from northern France likewise was up to the mark in our tests; in the North Bohemian and Moravian seed is much better.

3. Seed originating from regions with a continental climate begin to grow too late in spring and cease too early in autumn. The weeds therefore have a good opportunity to take their place during this time. But here also there are exceptions. We use orchard grass from the United States and timothy and alsike from Canada with very good results, as the difference in the yield compared with European seed is not very large. Some Canadian red clover strains from southern Ontario proved to be very good, and surpassed not only two French varieties but also one red clover of Swiss origin. Others from the same district were much lower. Two samples of variegated alfalfa from southern Ontario outyielded alfalfa from southern France and Italy. On the other hand Cossak and Grimm alfalfa did not do well under our climatic conditions.

4. Seed from the north as a rule has a good cultural value but it is often too late and for this reason is not suitable for mixtures.

5. Seed from the west (coasts of the Atlantic) demands mild winters and for that reason is often found unsatisfactory.

These experiments have provided us not only with accurate information regarding the value of seeds of different origin with respect to winter-hardiness, but also with regard to length of duration. It must be remembered that our mixtures have to be used from 4 to 6 years. In many respects they are therefore similar to those established in Great Britain and Ireland, although they differ in other respects because we prefer cutting for soiling to pasturing. The expected yield of hay from the grass and clover mixtures is high, and should be 130 cwts. to the acre in the second year, and 100 and 80 cwts. respectively the following years. Grazing is only practised in the autumn of the third year and later on.

The grass and clover mixtures as sown in Denmark have much more resemblance to our mixtures. Denmark has furnished some excellent data on the superiority of mixtures over pure clover or pure grass. In 73 different experiments made from 1900 to 1912 the following results were obtained:

Taking the yield from grasses as 100, the yield from pure clover in the second year was 192, in the third 106, while the grass and clover mixtures stood at 222 and 160 respectively. The principal advantage of mixtures lies in the fact that the grasses take the place of the clover when it disappears, thus assuring a good yield in the third and subsequent years. These advantages are strikingly illustrated in Figure 15.

The yield of mixtures in Central Europe is much larger than in a northern country like Denmark. The same advantages hold good in both cases, however. The roots of the different species utilize the soil at different depths; the grasses benefit by the decaying roots of dead clover plants. Maximum yields can not be expected, however, unless the main advantage is kept in mind when compounding the mixture, namely, that the different species must succeed each other, one after the other reaching the culminating point of their development over a period of years.

A very important factor is the choice of the nurse crop. Best suited are cereals cut for green forage. If the cover crop is left to ripen its respective value as a nurse crop diminishes in the following order: (1) spring barley, (2) winter spelt, (3) winter wheat, (4) oats, (5) winter rye, (6) winter barley. (Figure 16). The two last named cereals are so unsuitable because in the spring, when the mixture is to be sown, they have already fully developed their root-system.

From Figure 17 it is evident that grasses suffer more from the nurse crop than clovers. Regularly the mixtures without cover crop show the highest proportion of grasses.

The main factor for the success of grass and clover mixtures is the judicious choice of proper components. The proportion of grasses and clovers must show a proper balance, and within these two classes the choice of an appropriate percentage for each species is important. These principles will be discussed in a second lecture.

LEGENDS FOR PLATES

Plate I.

Figure 1. Comparative curves of mean monthly temperatures in Canada and Switzerland.

Figure 2. Comparison of annual and monthly precipitation in Canada and Switzerland.

Figure 3. Left: Graph illustrating the system of soil classification. Right: Results of 480 physical analyses of representative Swiss soils.

Figure 4. Frequency of acid and alkaline soils in Switzerland.

Plate II.

Figure 5. Village of Kestenholz. The distribution of fields shows clearly the influence of the three field system (photo by Ad Astra Aero).

Figure 6. District with alternate husbandry (Hirsbrunnen-Affoltern, Kt. Bern). (Photo by Ad Astra Aero).

Plate III.

Figure 7. Results of 2,265 analyses of grass for the determination of phosphoric acid and potash deficiencies in soils.

Figure 8. Meadow with *Anthriscus silvestris* predominating.

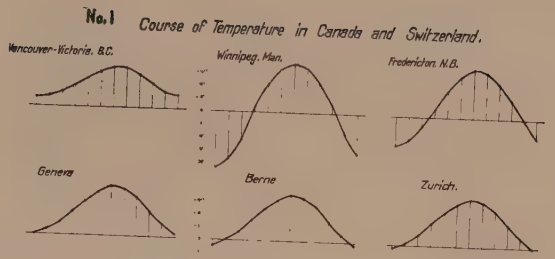
Figures 9 and 10. Legends shown in plate.

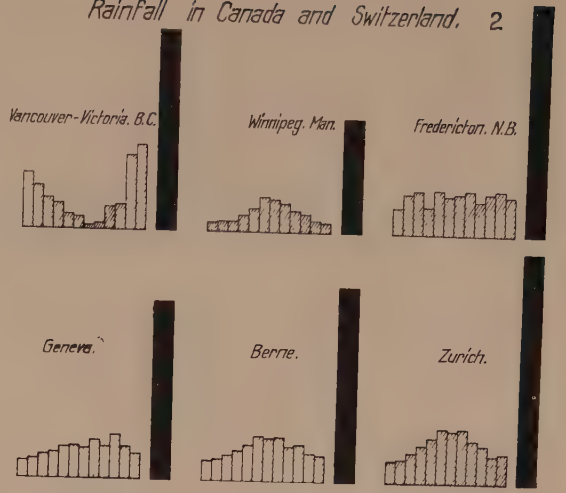
Plate IV.

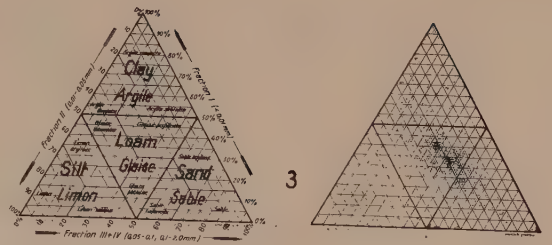
Figures 11-14. Legends shown in plate.

Plate V.

Figures 15-17. Legends shown in plate.


No. 1 Course of Temperature in Canada and Switzerland.
Vancouver-Victoria. B.C.
Winnipeg. Man.
Fredericton. N.B.
Geneva
Berne
Zurich.


Rainfall in Canada and Switzerland. 2
Vancouver-Victoria. B.C.
Winnipeg. Man.
Fredericton. N.B.
Geneva.
Berne.
Zurich.


Clay
Argile
Loam
Silt
Limon
Glaise
Sand
Sable
3

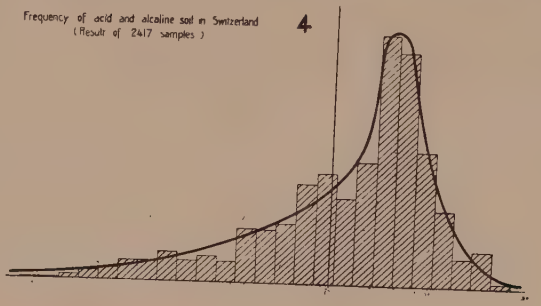
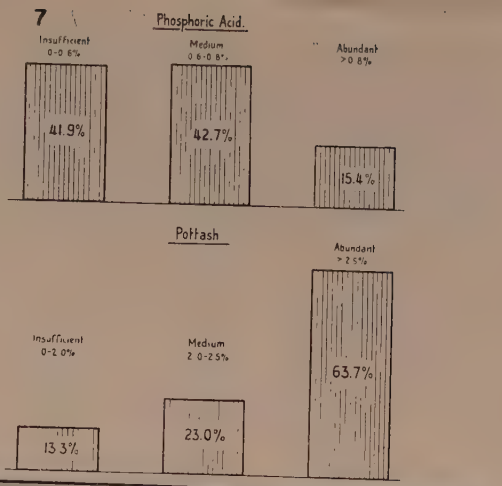
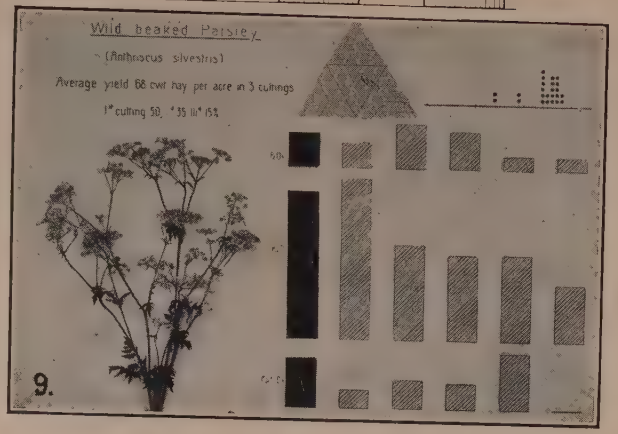

Frequency of acid and alcaline soil in Switzerland
(Result of 2417 samples)
4

PLATE I.

PLATE II.


7
Phosphoric Acid.
Insufficient 0-0.6%
Medium 0.6-0.8%
Abundant >0.8%
41.9%
42.7%
15.4%
Potash
Abundant >2.5%
Insufficient 0-2.0%
Medium 2.0-2.5%
63.7%
13.3%
23.0%

8


Wild beaked Parsley
(Anthriscus silvestris)
Average yield 68 cwt hay per acre in 3 cuttings
9.

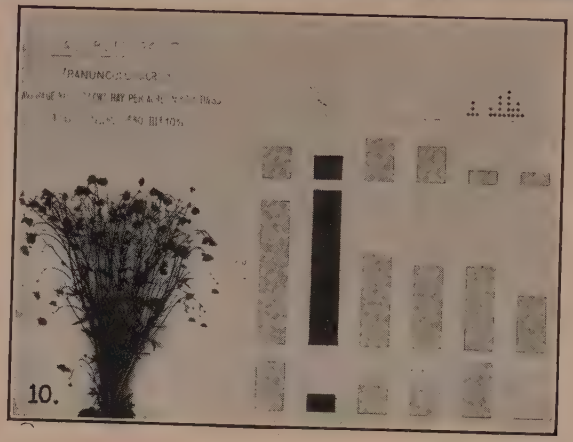
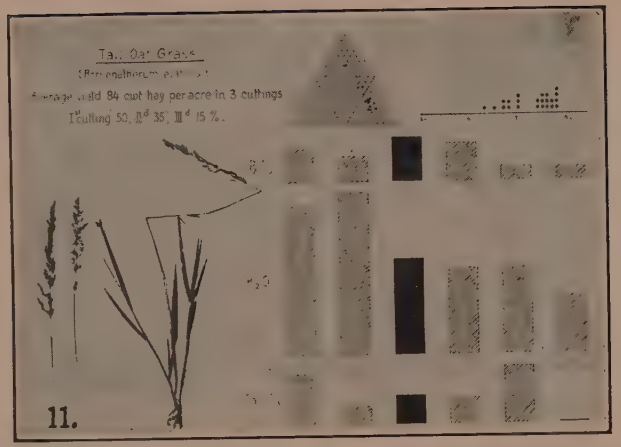
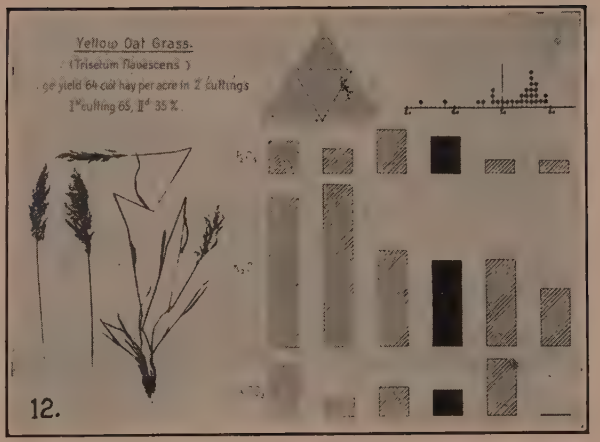
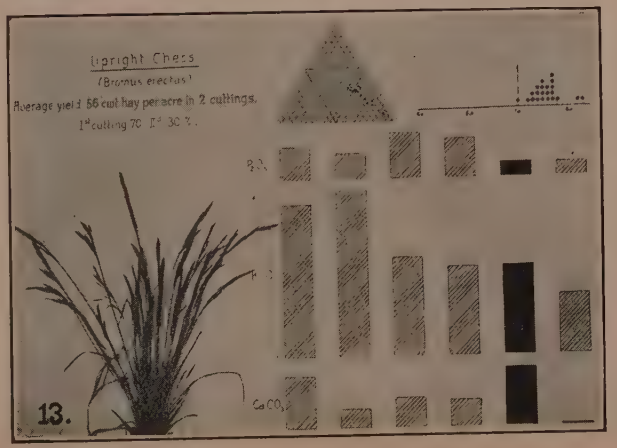

10.

PLATE III.


Tall Oat Grass.
(Arrhenatherum elatius)
Average yield 94 cwt hay per acre in 3 cuttings
I^st cutting 50, II^d 35, III^d 15 %.
11.


Yellow Oat Grass.
(Trisetum flavescens)
Average yield 64 cwt hay per acre in 2 cuttings
I^st cutting 65, II^d 35 %.
12.


Upright Chess
(Bromus erectus)
Average yield 56 cwt hay per acre in 2 cuttings.
I^st cutting 70 II^d 30 %.
13.

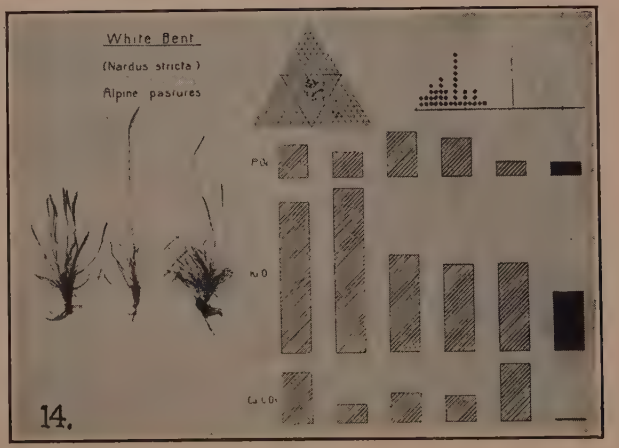
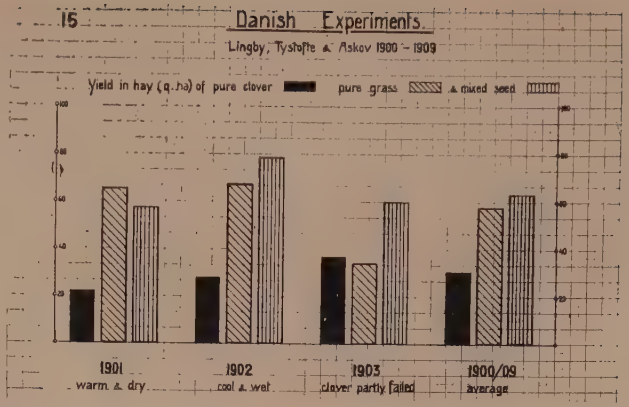
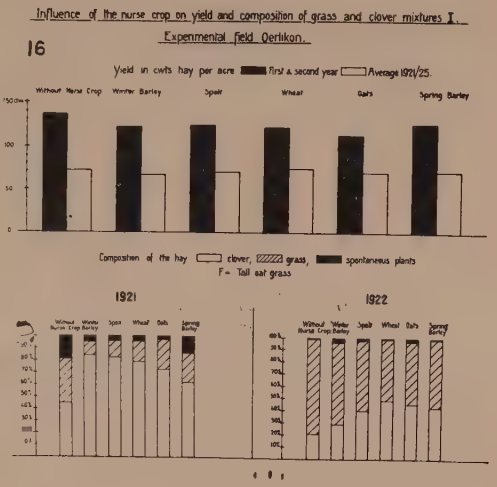

White Bent
(Nardus stricta)
Alpine pastures
14.

PLATE IV.


15
Danish Experiments.
Lingby, Tystofte & Askov 1900 – 1909
Yield in hay (q. ha) of pure clover
pure grass
& mixed seed
1901
warm & dry
1902
cool & wet
1903
clover partly failed
1900/09
average


Influence of the nurse crop on yield and composition of grass and clover mixtures I.
16
Experimental field Oerlikon.
Yield in cwts hay per acre
first & second year
Average 1921/25.
Without Nurse Crop
Winter Barley
Spelt
Wheat
Oats
Spring Barley
Composition of the hay
clover,
grass,
spontaneous plants
F = Tall oat grass
1921
1922

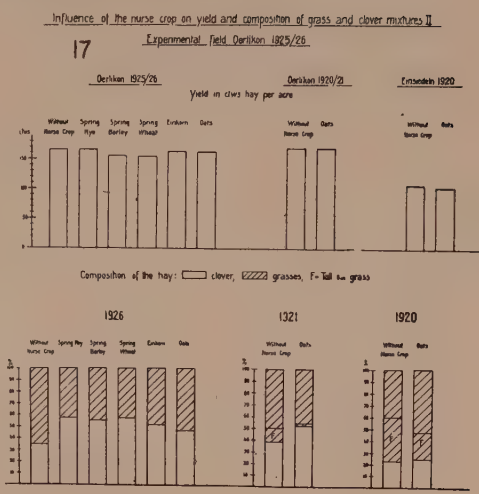

Influence of the nurse crop on yield and composition of grass and clover mixtures II
17
Experimental field Oerlikon 1925/26
Oerlikon 1925/26
Oerlikon 1920/21
Ernsedein 1920
Yield in cwts hay per acre
Without Nurse Crop
Spring Rye
Spring Barley
Spring Wheat
Einkorn
Oats
Composition of the hay:
clover,
grasses,
F = Tall oat grass
1926
1921
1920

PLATE V.

STUDIES ON ICE CREAM

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The ice cream industry, as such, is a development of the twentieth century. The Dominion Bureau of Statistics places the production in Canada in 1926, the latest year on which complete data on ice cream are available at the time of writing, at 4,709,641 gallons. This represents a per capita consumption of approximately one-half gallon per year, which may be compared to the 6.33 gallons per year in the District of Columbia in the same year (*6*). Likewise, it may suggest the possibilities in Canada when it is considered that the International Association of Ice Cream Manufacturers, an organization started in the United States but now including Canada, as well as several other countries, launched a campaign in 1926 to double the consumption of ice cream in the United States in a period of five years. Were the population to remain stationary and our production to increase even to half the present figure in Columbia, the dairy industry in Canada (allowing for the difference in the size of the gallon) would prosper to the extent of having a market for another 12,000,000 pounds of milk fat at a price ranging from 2 to 5 cents per pound above that paid to the producer for highest grade fat for butter-making purposes.

Ice cream has risen above its one time status as a confection. It is a food (*11*) of the highest type and belongs to the dairy products family, recognized as so important in the diet of modern man. Because it is a whole milk product it is susceptible to the same dangers of deterioration and the posible spread of disease (*2*) as fluid milk and therefore must be under the strictest sanitary control measures. It is subject to variation in composition to a greater extent than milk. This is because the several milk constituents may be obtained from sources of varying concentration of those elements. Accordingly, the consumer has a right to an assurance of controlled composition.

Because of these needs and because very little of a specific nature concerning commercial ice cream is known by the people at large the following investigations were undertaken.

THE SAMPLES STUDIED

Samples of commercial ice cream were bought through the regular trade in Winnipeg. These represented four wholesale establishments and five plants where the product was dispensed on the premises of the manufacturer. They were obtained from fifteen retailers. Analyses were made upon arrival at the laboratory or the samples were held in an ice cream cabinet at 0°F. until wanted, not over twenty-four hours in any case, however.

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STUDY NO. 1—PER CENT FAT

Although in the pioneer stages of the industry fat was looked upon as the principal milk ingredient in ice cream, the modern commercial manufacturer is placing less importance on this factor and more upon a better balance between fat and other milk ingredients. It is argued that not only is the product a superior food but one which can be made with more profit to the industry, since a larger quantity of the otherwise unmerchandisable solids-not-fat can be utilized to good advantage. Several states of the Union to the south have set the minimum fat standard as low as 8 per cent while in Canada in 1926 the Federal standard was lowered from 14 to 10 per cent, several of the provinces, however, still retaining a higher minimum. It should be noted, of course, that a minimum standard is fixed for legal purposes only. Because of the competitive nature of the business the commercial product may and does contain varying amounts of fat.

Method of Analysis

A slight modification of the Babcock Gerber method described by Moore and Morse (*8*) and recommended for factory use was used in making the fat readings. An 18 gram 10 per cent milk bottle was used and the results doubled, rather than a 9 gram 20 per cent bottle as used by them. The latter bottle is not in use in Canada. This method gave very satisfactory results in preliminary trials when compared with a modified Babcock method described by Fisher and Walts (*3*) and making use of 10 c.c. of 95 per cent ethyl alcohol, and two methods described by Gibson (*5*), one of which is a slight modification of the American Association test for buttermilk.

In unpublished work by the author, with 15 samples of ice cream tested for fat by these four methods the one selected for this study gave results in which the fat column was invariably clear and in which duplicates checked within one graduation of the milk test bottle. The other methods were not consistent in giving duplicates that checked or readings that were readable. In the method adopted the results were high consistently, as much as one per cent in some cases. The authors of this method suggest the possibility of slightly higher readings, but state that the solubility of amyl alcohol is not great enough to be a factor in the test when only enough is used to secure a clear fat column. In the light of an article published recently by Thurston and Peterson (*10*), where the accuracy of Gerber methods for fat in buttermilk is questioned because of the possibility of the reading being the total of the fat and lecithin, it may be possible that the method as followed gives results slightly high for ice cream. For practical purposes in this study, however, the results obtained are relative, if not absolute.

The method is as follows:

1. Melt about four ounces of ice cream and warm to about 120°F. in a stoppered container. Mix thoroughly.
2. Weigh exactly nine grams into a 10 per cent 18 gram milk test bottle.
3. Add 9 c.c. of distilled water.
4. Add 1.8 c.c. of amyl alcohol and mix thoroughly.

5. Add 17.5 c.c. of diluted commercial sulphuric acid (94 c.c. of acid to 6 c.c. of water for chocolate ice cream or 87 c.c. of acid to 13 c.c. of water for other flavors) in three portions and mix thoroughly after each addition of acid. Finally give a vigorous shaking.
6. Centrifuge five minutes.
7. Add water at 140°F. to bring contents to the bottom of the neck.
8. Centrifuge two minutes.
9. Add water at 140°F. to bring the fat into the graduated portion of the neck.
10. Centrifuge one minute.
11. Place in a bath at 130 to 140°F. for five minutes.
12. Using dividers, read to the bottom of the meniscus.
13. Double the reading to get per cent.

Results

A study of the results tabulated in Table 1 reveals (1) that the fat content of ice cream as manufactured is well above the legal federal minimum for fat, (2) that there is wide variation in fat content of ice cream even from the same manufacturer and (3) that there is need for more definite control of the composition of the mix by the manufacturer if the public is to receive a uniform product and the manufacturer reap his highest profits.

Table 1. *The percent fat in 28 samples of ice cream from 9 plants in Winnipeg.*

Plant	Sample	% Fat	Plant	Sample	% Fat
1	A	16	5	A	13.2
	B	15.9		B	12.0
	C	17.4	6	A	13.0
2	A	15.0		B	16.0
	B	14.4		C	16.2
3	A	12.6		D	17.2
	B	13.1	7	A	17.2
	C	15.6		B	16.8
	D	18.4		C	17.2
	E	13.6	8	A	17.2
4	A	15.6		B	17.4
	B	14.0	9	A	15.4
	C	13.8		B	12.3
	D	14.8		C	14.6

STUDY NO. 2. THE PER CENT TOTAL SOLIDS

With the fat content of ice cream the total solids must be considered in order to know its food value or to have control over its flavor and texture. The other solids which go to make up what is known as the total solids are milk-solids-not-fat,—casein albumen, lactose and the mineral solids of milk,—sugar and gelatine or some kind of stabilizer. The amount of sugar ranges from 12 to 15 per cent and is determined largely by the demands of the consumer for a sweet product. Gelatine is used in small amounts, .3 to .5 per cent only; it serves to improve the texture of ice cream and, in the light of our present knowledge of nutrition, adds appreciably to the food value. Milk-solids-not-fat in the form of those normal in milk to the extent of about 8.5 per cent (in coffee cream about 7.3 per cent), or in concen-

trated form in powdered skim milk, supplement the fat to give the characteristic flavor and texture of ice cream. Apart from the fat they are responsible for the chief variation in the total solids content. In old fashioned or home made ice cream (*11*) they are present to the extent of about 6 to 7 per cent and in the modern commercial product to from 9 to 12 per cent.

Method of Analysis

The method of analysis is essentially one of making a sample moisture free and obtaining the percentage of solids gravimetrically. The method used is described by Fisher and Waltz (*4*). It is as follows:

1. About 4 ounces of ice cream were melted and warmed to about 25°C. in a bath not above 30°C.
2. The sample was mixed well and one gram weighed directly into a dried and tared aluminum pan about 5 c.m. in diameter. This was covered while weighing.
3. One cubic centimetre of hot distilled water was added and thoroughly mixed with the ice cream.
4. The dishes were placed on an electric hot plate at 180°C. and the moisture carefully evaporated until the first traces of brown appeared.
5. Drying was continued in a constant temperature oven at 100°C. for three hours.
6. The dried samples were cooled in a dessicator and weighed.

Results

The data on 28 samples are given in Table 2. The result is the average of two samples in each case. The total solids ranged from 32.72 per cent to 41.71 per cent.

Table 2. *The per cent total solids in 28 samples of ice cream from 9 plants in Winnipeg.*

Plant	Sample	% T.S.	Plant	Sample	% T.S.
1	A	39.38	5	A	38.15
	B	40.67		B	36.61
	C	41.71	6	A	39.11
2	A	37.49		B	38.77
	B	37.25		C	39.10
3	A	38.54		D	40.41
	B	39.00	7	A	32.72
	C	38.00		B	33.48
	D	41.51		C	33.55
	E	39.39	8	A	36.46
4	A	38.90		B	36.48
	B	36.88	9	A	39.68
	C	38.90		B	33.20
	D	37.82		C	39.72

STUDY NO. 3. THE BACTERIAL COUNT AS A MEASURE OF SANITARY QUALITY*

The bacterial count as determined by the plate method is accepted generally as a measure of the sanitary care taken in the production and process-

*The author gratefully acknowledges his appreciation of the use of the laboratory and media of the Department of Bacteriology for the bacterial counts.

ing of any fresh milk product. To date control bodies have not applied a bacteriological standard to ice cream except in the case of the state of California, which has placed a maximum count of 150,000 bacteria per gram as the legal limit. Olson and Fay (*9*) in 1925 reported that it was possible and practical to produce an ice cream containing less than 100,000 bacteria per gram under all plant conditions, provided that efficient pasteurization was practised, that the temperature was controlled during ageing and that equipment was properly washed and sterilized. Fabian suggested 100,000 bacteria or less per gram as a bacteriological standard in 1926. This may seem a high standard but it must be recalled that the count as determined may be increased appreciably during processing by the actual breaking up of clumps of bacteria. In a work by the author (*7*), this factor in the homogenizer alone was responsible for increasing the count as much as threefold in some of the runs. Accordingly it would seem reasonable to allow a little more toleration than in the case of fresh milk.

Method of Analysis

The procedure as outlined by the American Dairy Science Association through its committee on bacteriological methods (*1*) was followed. The samples were weighed directly into a 90 c.c. dilution blank and standard agar was used as a medium. Samples were plated in duplicate in the 1/1000 and 1/10,000 dilutions and incubated for 48 hours at 37°C.

Results

The results are given in Table 3. Counts ranging from 2,500 to 670,000 bacteria per gram were obtained. Eleven of the 28 samples (39 per cent) were below the 100,000 standard suggested.

Table 3. *Bacterial counts on 28 samples of ice cream from 9 plants in Winnipeg.*

Plant	Sample	Count per gram	Plant	Sample	Count per gram
1	A	171,000	5	A	16,500
	B	4,000		B	5,500
	C	370,000	6	A	154,000
2	A	126,000		B	86,000
	B	424,000		C	128,000
3	A	302,000		D	113,500
	B	670,000	7	A	23,000
	C	356,000		B	150,500
	D	204,000		C	20,000
	E	33,000	8	A	49,000
4	A	211,000		B	58,000
	B	258,000	9	A	16,000
	C	56,500		B	2,500
	D	105,500		C	9,500

STUDY NO. 4. THE WEIGHT OF A PINT OF ICE CREAM

Ice cream is sold by bulk. Unlike other milk products the weight of a measured volume varies widely so that a factor other than chemical composition as determined by the fat and total solids content enters into a consideration of what the consumer gets for his money or what the retailer gives for it. The question of weight is engaging the attention of the industry.

Commencing on June 11, 1928, a firm at Salem, Ohio, started selling ice cream by the pound which is a new step in the business.

Method of Procedure

At the time of purchase a pint of plain ice cream was asked for. If bricks were not available bulk ice cream was dished into a pint carton or pail. The net weight of the ice cream, thus obtained, was determined on a scale graduated in quarter ounces.

Results

The weight of 28 pint samples of plain ice cream ranged from 9 to 21¼ ounces The 14 cartons filled from the machine weighed from 9¼ to 13¼ ounces while the 14 pints filled from bulk ranged from 9 to 21¼ ounces.

Table 4. *Weight of 28 pints of ice cream from 9 plants in Winnipeg.*

Plant	Sample	Weight (in ounces)	Plant	Sample	Weight (in ounces)
1	A*	9¼	5	A*	13¼
	B*	11½		B	15¼
	C	9	6	A*	10
2	A*	12½		B	16¾
	B*	11½		C	14
3	A	17		D	14
	B*	11½	7	A	18¾
	C	21¼		B	16½
	D	10		C	20
	E*	11	8	A	12¾
4	A	11½		B	16
	B*	11¼	9	A*	10
	C*	9¾		B*	10¼
	D*	11		C*	10

*The samples marked with an asterisk were on the market in cartons.

STUDY NO. 5. THE VOLUME OF A PINT OF ICE CREAM

A pint is a definite unit of volume. It represents 567.93 cubic centimetres when transposed to the metric system. The volume of 14 so-called pint bricks was obtained by lowering the hardened ice cream into a full measure of cold water and measuring in a cylinder graduated in cubic centimetres the amount of water displaced by the ice cream. The results ranged from 476 to 600 c.c. They are presented in Table 5.

Table 5. *The volume in cubic centimetres of 14 pint bricks of cartoned ice cream.*

Plant	Sample	Volume in c.c.'s	Plant	Sample	Volume in c.c.'s
1	A	548	4	B	588
	B	578		C	476
2	A	585		D	565
	B	578	5	A	550
3	B	535	6	A	490
	E	536	9	A	600
				B	590
				C	590

Discussion of Results

The results show a wide variation in the amount of food in a given quantity of ice cream. Ice cream of 18.4 per cent fat contains 53 per cent

more fat than ice cream of 12 per cent fat. This difference may be increased appreciably when one considers the weight factor along with composition. One pint of ice cream weighed 21¼ ounces, representing 125 per cent more weight than was obtained in the pint weighing 9 ounces. It is reasonable to assume that the lighter pint might be the one testing the lower number, which would give 1.08 ounces of fat. If the heavier pint tested the higher number the amount of fat would be 3.91 ounces. This represents a difference of 262 per cent of the 1.08 ounces. One sample (9b) testing 12.3 per cent fat and weighing 10¼ ounces contained 1.26 ounces of fat. Another (7c) testing 17.2 per cent fat and weighing 20 ounces contained 3.44 ounces of fat. This represented an actual difference of 173 per cent of the 1.26 ounces.

Summary

The following findings on 28 samples of ice cream purchased from the regular trade in Winnipeg are recorded:

1. The fat content as determined by a practical factory test ranged from 12.0 to 18.4 per cent.
2. The total solids ranged from 32.72 to 41.71 per cent.
3. The bacterial count ranged from 2,500 to 670,000 bacteria per gram of ice cream. 39 per cent of the samples were below 100,000 bacteria per gram.
4. The weight of a pint of plain ice cream ranged from 9 to 21¼ ounces. The 14 cartons filled from the machine varied from 9¼ to 13¼ ounces, while the 14 pints dished from bulk varied from 9 to 21¼ ounces.
5. The volume of 14 pint bricks filled from the machine ranged from 476 to 600 cubic centimetres.

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CURRANT RUST CONTROL*

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Little attention has been given to the control of rust on currants in recent years, yet the causative fungus has been the subject of much investigation and legislation because of its destructive effect on the white pines. Currant rust and white pine blister rust are caused by the fungus *Cronartium ribicola* F. de Wald. The forest tree attacked by this fungus is of greater economic importance to Canada than the currants but there are many sections of the country where the white pine is not conspicuous as a forest tree and where currants, especially black currants, are cultivated. It is for the benefit of such areas that the data contained herein are presented.

It is a common sight in local black currant patches to find the plants defoliating in midsummer because of the presence of this fungus. The lower surface of the leaves is covered with the orange coloured uredinial and telial stages of the rust fungus, which eventually causes defoliation. The effect on yield is self-evident to the grower and the weakening effect on the plant, frequently aggravated by a second growth of foliage in the late summer, is such as to keep a plantation in too poor a condition to produce good crops.

For the last three years this disease has been under general observation to determine if an economical control on currants could not be obtained. The successful use of sulphur as a fungicide for the control of other rusts has encouraged tests on the effect of sulphur dusts on currant rust in the field.

A brief summary of the use of sulphur as a fungicide against rust diseases of plants was given by Greaney (*2*) and further elaboration is unnecessary except to refer to specific references on *Cronartium ribicola.* Doran (*1*) found that sulphur was toxic to the aeciospores of this fungus when exposed for five hours at 26°C. He concluded that infection by aeciospores would be difficult to prevent but that summer dusts would probably inhibit the spread of the uredinial stage. Howitt and McCubbin (*3*) found that sodium polysulphide sprays gave partial control of the rust under Ontario conditions.

Under local conditions in Nova Scotia the maximum temperature for any one day immediately following the liberation of aeciospores has been approximately 24°C. In each of the three years under observation, maximum temperatures above 20°C. have been reported for two or three days within five days following the first application. Subsequent applications have invariable been followed by maximum temperatures above 22°C. and in some seasons up to 33°C. Observations made on the treated and untreated plots when primary infection was first found, revealed that a very pronounced control had been obtained and that in the field temperatures above 20°C. following the first application of sulphur were sufficient to prevent infection by aeciospores.

*Contribution from the Division of Botany, Experimental Farms Branch, Department of Agriculture, Ottawa, Canada.

Experimental Work

In these experiments three brands of commercial dusting sulphur have been used with equal success under similar conditions. Previous treatments with copper fungicides did not give satisfactory results and none was included in these field tests.

The first application in the spring was timed according to the condition of aecia on white pines about 300 yards distant from the patch. When the aecia were mature and commencing to break open to discharge spores, the first application was made. The leaves on the black currants were about one-half inch in diameter at this time—May 5th to 15th—depending on the earliness of the season. The second application was made just before the blossoms opened. A third application was given about two weeks later and a fourth 10-14 days after the third.

The following table gives a three year summary of the effect of three and four applications of sulphur dust and two applications of lime-sulphur on three varieties of black currants:

Treatment	SAUNDERS		BOSKOOP		BLACK VICTORIA	
	Per cent leaves affected	Per cent infection	Per cent leaves affected	Per cent infection	Per cent leaves affected	Per cent infection
2 appn. L.S.*	92.3	1.1	42.6	1.2	97.6	3.0
3 appn. S. dust	69.32	tr.+	27.37	tr.	75.25	3.5
4 appn. S. dust	23.68	tr.	16.6	tr.	32.4	tr.+
No treatment†	100.00	50.0	---	---	---	---

*Lime-sulphur solution 1.008 sp. gr. used in two early applications only—no subsequent application given.

†Saunders variety only, used as control.

Records were taken early in August, usually a week or so after picking. Some of the untreated plots were losing their leaves by this time on account of rust. By September 1st the check bushes were bare and second growth starting. The plots that received three and four applications of dust retained their foliage until late October or early November.

In the above table the column "per cent infection" refers to the relative surface of the leaves covered with rust sori. A "trace" is applied to those leaves that show a few scattered sori. "Trace+" applies to counts in which occasional bushes contained a little more than a trace, but not averaging one per cent. The "no treatment" plot averaged 50 per cent infection in two of the years and 52.5 per cent infection on larger counts taken in 1927. Several thousand leaves were examined each year and the figures in the table give a fair indication of the actual condition of the plots.

Discussion

It is quite noticeable that there is a gradual decrease in the percentage of leaves affected and percentage infection as the number of applications increased. A fifth application has not been used but it is reasonable to conclude that if such an application was made ten to fourteen days after the fourth there would be a still further reduction in the amount of rust

infection, as the spread at that time of the year is entirely by urediniospores and these are very susceptible to sulphur fungicides.

It will be observed from the above data that while defoliation has been prevented there is still a trace of rust present. The presence of even this small amount of inoculum undoubtedly prolongs the period of spore dissemination during which white pines, if present in the vicinity, may become infected. The benefit which might accrue from the treatment of currants is therefore confined to the currants. In districts where white pines are grown it is doubtful if these treatments would have any effect on preventing infection by the blister rust fungus.

In making the applications of spray or dust the material should be applied so as to strike the under surface of the leaves. Rust infections occur on the lower surfaces and these must be protected. If a sprayer is used, the rod should have the nozzle on an angle to facilitate the upward direction of the spray. If a duster is used, the blower can be easily turned upward by using an extension and goose neck length.

Conclusions

1. Defoliation of black curants by currant rust can be prevented by four applications of sulphur dust.

2. Applications of fungicides must be directed towards the under surfaces of the leaves.

3. Lime-sulphur spray solution 1.008 sp. gr. can be used before bloom, if necessary, to control other pests, in place of the dust.

4. The variety Boskoop is more resistant to rust under local conditions than Black Victoria or Saunders. With rust controlled, Saunders variety is the heaviest yielder.

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NOTES

THE FIREBLIGHT SITUATION IN ONTARIO*

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The bacterial blight of apple, pear and quince trees, otherwise known as fireblight, pear blight, twig blight, blight canker, etc., has been relatively scarce this year (1928) around Guelph and in the Grimsby, Vineland and St. Catharines fruit district. Compared with the conditions that prevailed a few years ago when we found the disease in almost every orchard, greatly reducing the apple yield and killing out pear trees and even pear orchards wholesale, the present comparative freedom from the disease is a striking and welcome contrast.

The question naturally arises—what is responsible for this comparative freedom from the disease this year? The logical follow-up question to this is—what can be done to ensure a continuance of this relative freedom from the trouble or, further, can measures be devised for stamping out the disease entirely?

It is customary for endemic infectious diseases to wax and wane, to break out occasionally as epidemics which gradually, or rapidly, rise to a peak of destructiveness and then slowly, or occasionally rapidly, decline. When the epidemic is at its height there is much consternation and distress and much seeking after advice, but when it has subsided to small proportions an attitude of indifference sometimes amounting to carelessness is apt to develop.

With regard to certain infectious diseases of man and animals, various theories have been put forward from time to time concerning the cause of the breaking out of epidemics followed later by their subsidence. One is that the pathogen may be fairly common in our midst, but usually in a low state of virulence producing only a few mild cases of the disease; but that when certain circumstances obtain, the virulence of the organism is enhanced and an epidemic breaks out. Another view is that the virulence of the pathogen may be fairly constant but that the powers of resistance of the individual vary with changing conditions, atmospheric or otherwise, and that when the resistance is low an epidemic occurs. A further development of this view is that the virulence of a pathogen varies, and the resistance powers of the individual also vary with changing conditions, so that when an increase in virulence of the pathogen is coincident with a reduction of resistance on the part of the individuals comprising a community, through changing atmospheric or other conditions, the most serious epidemics occur.

Still another theory is that in connection with certain infectious diseases, e.g. typhus fever and malaria, the virulence of the virus and the resistance

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of the individual may both be constant, and that the breaking out of an epidemic and its continuance are coincident with the prevalence of the insect carriers of the virus, the body louse for typhus fever and the anopheles mosquito for malaria. The question arises—are these theories regarding infectious diseases of man and animals applicable to bacterial diseases of plants? The answer to this question is that in the light of the last thirty years' researches on the part of numerous investigators, there is about as much ground for considering that the above theories apply to the bacterial diseases of plants as there is to their applying to the infectious diseases of man and animals.

With some bacterial plant pathogens it has been found that, following their isolation from cases of the disease in plants, repeated transference on laboratory culture media has resulted in lowering their power to produce the disease on subsequent inoculation into the same kind of plants from which they were originally isolated. With other bacterial plant pathogens, however, repeated transference on laboratory culture media, even over a period of years, has failed to lower their virulence, so that their power to produce the disease on inoculation appears to be a constant property.

Apart from the virulence of the pathogen, however, it is generally recognized that atmospheric and soil conditions have a marked influence on the prevalence of certain bacterial diseases of plants, as for instance, the high humidity obtaining during a wet season markedly favouring the spread of the bacterial soft rot of vegetables and the bacterial wilt of crucifers. Then again, the presence or absence of insect carriers of the pathogen may be responsible for the presence or absence of an epidemic as in the case of the bacterial wilt of cucurbits, the spread of which is largely dependent on the activities of the cucumber beetle as carrier of the causal organism. We must, however, have the causal organism before we can have the disease. Its virulence may wax and wane, the conditions favourable for its spread may obtain and then later pass away, but whatever the surrounding conditions may be, whether favourable for the disease or not, if the pathogen is not there the disease will not develop.

Turning now to the specific question of firelight, and to the original question of this paper as to the reason for the lack of the disease this year as compared with the abundance of the disease a few years ago,—

For twenty years we have steadfastly advocated the policy of cutting out fireblight infections, preferably as soon as observed, taking care to cut well below the invaded area and to burn at once the material that is cut away. Some orchardists have adopted this policy with good results, thereby getting their orchards clean; others have attempted it but failed in immediately getting complete eradication of the disease. In neglected orchards the disease has been allowed full sway; these are the cases that are responsible for our still having the disease with us, for from them it is liable to spread in all directions when conditions are favourable.

It has been well established that the pathogen does not live over winter in the soil. It is not a soil organism. It has been observed that

where the infection is confined to the thin twigs it usually dies out during the following winter. It has been demonstrated that the pathogen will live several weeks or even months, in the bark of blight-cankered limbs that have been cut away and left lying around. As these dry out, however, the pathogen dies with the dying wood. It has been conclusively proved that fresh outbreaks of the disease in the spring and early summer owe their origin to hold-over blight-cankers in the bark of branches, a half-inch or more in thickness, and cankers in the trunks of trees that were active during the previous season.

In the spring when the sap begins to flow the bacteria in the bark tissue surrounding the hold-over cankers become active, and as a result of their activities a gummy exudate containing the bacteria in large numbers is liable to ooze out to the surface of the cankering tissue. Formerly it was considered that insects getting contaminated with this gummy exudate were responsible for most, if not all, of the primary blossom and twig infection. It has recently been shown, however, that a considerable, if not a major percentage, of primary infections in the spring and early summer may be caused by rain washing the bacteria-infested gummy exudate from active cankers and splashing it on leaf and blossom bud clusters and young terminals, into the young tissue of which the bacteria may gain entrance without insect aid. Thus originate the primary infections in the spring, from which, subsequently bees and other flower-visiting insects and aphids and other sucking insects get contaminated. These insects spread the disease far and wide, establishing large numbers of blossom and twig, water sprout and sucker infections, many of which may result in the development of cankers in the bark of the branches or tree trunks from which the infected blossom spurs, twigs, water sprouts or suckers grow.

From the above it will be seen that the requirements for an epidemic of fireblight are, first, hold-over cankers in the bark of branches or trunks of trees, that were active the previous season; second, gummy exudate oozing to the surface of these cankers when they become active in the spring; third, rain to splash, or cause this bacteria-infested exudate to drip on to the adjacent young growth of blossom and leaf clusters and twig terminals, thus establishing primary infections from which bees, aphids and other insects carry the bacteria in all directions to new locations and so cause an epidemic. Thus, if we have no hold-over cankers to begin with in the spring there will be no outbreak of fire-blight during the summer.

Though we know that many growers have adopted the policy of radically cutting out all cases of the disease from their orchards, we cannot imagine that everyone did this last year. Consequently there must have been some hold-over cankers in some orchards. Why, then, was there not an outbreak of the disease from these cankers during the season? We do not know for certain, but the probable answer to the question is that these cankers were not active enough to produce gummy exudate on the surface sufficiently early in the season to cause much primary blossom and twig infection; consequently there was not the opportunity for bees,

aphids and other insects to get contaminated with the blight bacteria, and so they did not spread the disease.

Three years ago we were petitioned to investigate and to give advice on a bad attack of fireblight in apple orchards centering around Thornbury, in the Georgian Bay district. On arrival there we were met by a number of apple growers who took us to orchard after orchard in which the trees were simply covered with fireblight. In some cases eighty to ninety per cent of the blossoms and young growth were killed out. In many instances the disease had passed down infected water sprouts to the bark of the larger limbs, and there established cankers which were rapidly extending with plenty of gummy exudate oozing out. In some cases where the cankers had got established in the crotch following inoculation through a watersprout, they were so far developed that the entire top of the tree was doomed, each main limb being canker-girdled at the base. In some cases large cankers had developed at the crown as a result of sucker infection, the suckers having been inoculated by contaminated aphids.

This was the first epidemic that had occurred in that district and it meant a heavy loss to the growers. They had noticed bits of fireblight for two or three years, but had not thought it of any consequence, and so had not troubled about it. From these neglected cases there undoubtedly had been some hold-over cankers, and spring conditions had been ideal for the establishment of primary infections from these, and bees, aphids and other insects, getting contaminated from them, had carried the blight bacteria to innumerable blossoms and twigs with the result that the orchards looked as though they had been scorched by fire,—a typical epidemic of fireblight.

Two years ago, in the early fall, we searched the two college orchards thoroughly for a sample of fireblight for class work. We failed to find a single specimen. We did, however, find the trees very much discoloured and disfigured, the foliage and twigs being black and sticky with aphid remains. There had been during the summer a very heavy aphid infestation. If there had been any blight cases present when the aphids came there would have been an epidemic as bad as, if not worse, than the ones we found in Thornbury the previous year.

A few years ago fireblight was widely prevalent in the college orchard. Year after year pear trees and apple trees were removed that had been killed by it. The disease was endemic, taking its toll every year, and the orchard was a perennial sorry spectacle. Eventually, the policy we had recommended for years was put into practice. Every tree was closely scrutinized twice or three times a year and every blighted part was carefully cut away and burned. In two years the orchard was free from the disease and has remained free ever since except for an occasional slight infection by bees bringing the germ from outside. Such cases however are not allowed to develop to any degree before they are observed and removed.

After a fireblight survey of the fruit district this fall during which we noticed such a relatively small number of cases of the disease, we came to the conclusion that this year presents by far the best opportunity that

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has happened in more than twenty years for stamping the disease out of the district. If only every apple and pear grower would carefully scrutinize his trees and cut out the few hold-over blight cankers before the sap begins to flow next spring, the trick would be done. If there are no hold-over cankers left there will be no fireblight epidemic, whatever seasonal conditions might be.

During the survey we saw a number of young pear orchards just coming into bearing. Judging from past experience we know that should fireblight be brought to them from any neighbouring hold-over cankers in a favourable season they would not last long. We have known pear orchards like them to be wiped out in three years after the blight had got established in them.

The reasons, then, that we offer as to there having been so slight an amount of fireblight this year around Guelph and in the Niagara fruit district, as compared with former years are, first, that during recent years there has been much cutting out and destruction of fireblighted specimens of apple and pear trees; second, that the hold-over blight cankers from last year were not sufficiently active in the early season to produce much gummy exudate from which early primary infections could be established by rain splashings on blossom clusters and twig terminals, thus preventing bees, aphids and other insects from getting contaminated with the fireblight bacteria and spreading the disease.

As hold-over blight cankers are responsible for continuing the disease from year to year in the orchard, and as there are relatively few cases of fireblight this year, a splendid opportunity is presented for apple and pear growers to rid themselves of the trouble by making a close scrutiny of their trees and radically cutting out all blighted parts and burning them before next spring.

NOTE ON A CONGENITALLY STERILE BILLY GOAT

A. Savage†
Manitoba Agricultural College, Winnipeg, Man.

[Received for publication February 23, 1929]

There is an old and widespread tradition that male goats are paragons of fertility, literally radiating that quality to such an extent that the mere presence of one of them in a cattle byre serves to prevent all forms of reproductive failure. The following note is in partial refutation of such nonsense: incidentally it may be of interest genetically, pathologically and practically.

The subject, a pure bred and registered Toggenburg, was born with two other kids, one a female, the other a free-martin. He was 23 months old and in excellent condition when brought under observation. At from 15 to 20 months of age he had been freely used on about a dozen nannies. Every one of these failed to pass an oestrus period: all returned to service.

Careful comparison with two normal animals failed to reveal any clinically determinable lesion. There being no oestrus females available, it was impossible to recover a sample of semen for microscopic study. The goat was therefore slaughtered and his genitalia examined after dissection.

The only gross tissue changes were in the epididymi and testes. Of these the former were slightly distended in the region of the globus major. The testes were practically identical. When sliced longitudinally their cut surfaces showed a number of small cheesy foci embedded in otherwise normal tissue. These points—(distended tubules containing inspissated sperm)—were irregularly stellate, not more than 2 mm. in diameter and most numerous in the proximal halves of the glands: indeed the distal portions were almost devoid of them.

No attempt was made to discover if motile sperms were present.

Microscopic examination of stained smear preparations disclosed the following principal features. The *vasa deferentia* contained a few, very few, morphologically normal sperm only. In the *epididymi* some complete sperm were found but the majority of them were represented by fragments, the result of the heads having become separated from the other parts at the connecting piece. Many such heads stained poorly with carbolfuchsine. The testicular picture was similar with, of course, the addition of spermatocytes and other transitional forms.

One distinctly abnormal type of sperm was rather abundant in the testicular smears. This form has been encountered previously in the semen of stallions and bulls but its origin remained obscure. It has not been hitherto described. As shown in Figure 4, it somewhat suggests a Zulu war club or "knobkerry". It is headless and consists of an axial filament covered at the posterior two-thirds or three-quarters by the sheath of the

†Professor of Animal Pathology.

tail, bare anteriorly and carrying a small knob at the tip of its naked extremity. This knob probably represents the sheath or spiral filament of the middle piece. Obviously, the thing is pathological.

Suitable pieces of one testis were excised from the proximal, middle and distal portions of the gland, fixed in Bouin's fluid and eventually sectioned in paraffin. Seen microscopically, the sections revealed degrees of degeneration quite unsuspected from the gross appearance of the gland. Scarcely a tubule was normal. The most startling change consisted of the distension of small groups of tubules with dense masses of sperm which had evidently been forced there from other parts because there was no epithelial lining at the sites of their accumulation. All degrees of epithelial degeneration were in evidence; a few areas of fibrosis indicated how the process eventually terminated. There was no evidence of infection or inflammation.

The above observations do not make it possible to state the exact cause of the sterility. The presence of a few normal sperm in the vasa deferentia prevents one assuming complete stenosis of the epididymi to have existed. On the other hand, the distension of these parts, the degeneration of the spermatogenic tubules and the presence of inspissated sperm show that a blocking of many individual tubules must have taken place. Whether or not the degenerating cells liberated toxins which resulted in the normally formed sperm becoming impotent, seems to be a purely theoretical consideration. It is at least plausible. But why the stenosis?

A remarkably similar case is described by Greenwood (*1*); indeed the two represent essentially the same condition. In both instances the males were born along with hermaphrodites. Theoretically the facts suggest that in the developing foetuses the influence of the male sex hormone upon the female with the resulting production of a free-martin may, in certain cases, be partially reciprocated. Practically they indicate that this type of sterile male could be avoided by the selection of sires born either alone or along with sexually normal animals.

My thanks are freely expressed to Dr. F. A. E. Crew and the staff of the Animal Breeding Research Department, Edinburgh, for the "scientific hospitality" and assistance without which this note would have been impossible.

REFERENCES

1. Greenwood, A. W., Veterinary Journal, *28*: No. 7. July, 1926.
2. Lillie, F. R., Journal Expt'l Zoology, *23*: pps. 371-451, 1917; also Science, *50*: pps. 183-4. 1919.

LEGEND FOR PLATE

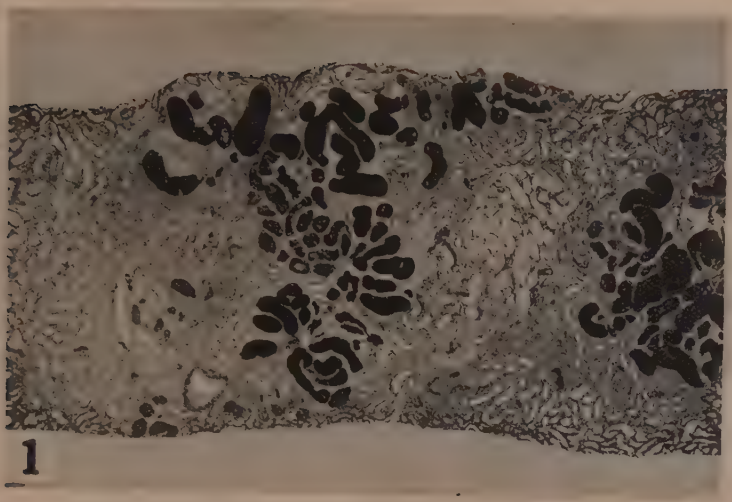
Figure 1. Section of testis x 10. (haematoxylin and eosin). The dark areas are tubules distended with sperm; the lighter ones show various degrees of degeneration.

Figure 2. A portion of the above x 50. Masses of inspissated sperm in distended tubules without epithelium.

Figure 3. Another part of the same section x 50. Flacid tubules with highly degenerate contents.

Figure 4. Club shaped or "Knobkerry" sperm x 750.

Figure 5. Normal goat sperm x 750.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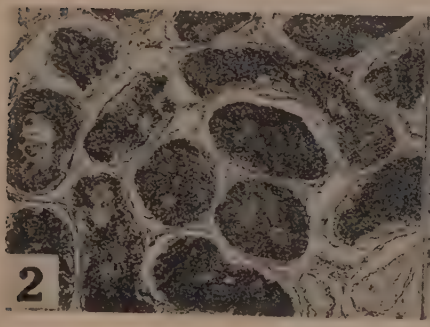
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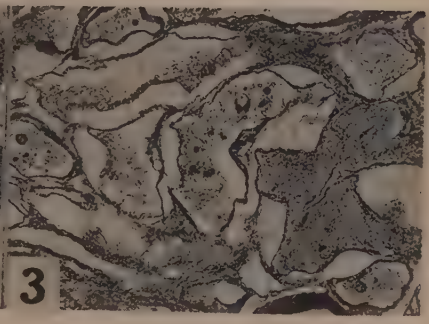
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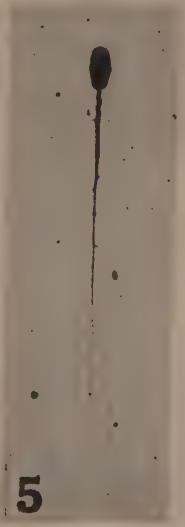
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WESTERN CANADIAN SOCIETY OF AGRONOMY

Report of Ninth Annual Meeting

The ninth annual meeting of the Western Canadian Society of Agronomy was convened in the physics theatre of the University of Saskatchewan on December 27, 1928. The meeting was called to order by the President, Mr. G. M. Stewart.

The minutes of the previous meeting were read and approved, on the motion of L. E. Kirk, seconded by M. J. Tinline.

The following special committees were appointed:

(a) *Resolutions Committee*: A. H. Joel, W. D. Hay, M. J. Tinline.
(b) *Nominations Committee*: W. H. Fairfield, L. E. Kirk, D. A. Brown.
(c) *Membership Committee*: J. B. Harrington, A. T. Elders, W. H. Fairfield.
(d) *Auditors*: H. Larson, S. Barnes.

The Secretary-Treasurer's report was given by Dr. J. B. Harrington. He mentioned the whole-hearted response of the members to the request for papers and stated that the excellence of these papers made it unnecessary to seek an outside speaker this year. He drew attention to the sound financial position of the society that had resulted from prompt payment of fees. He suggested that the time was ripe for increasing the membership of the society by approaching eligible non-member workers in agronomy and related fields. On motion of G. D. Matthews, seconded by R. E. Everest, this report was adopted.

The presidential address was delivered by Mr. G. M. Stewart.

It was moved by G. D. Matthews and seconded by S. J. Sigfusson that only half the annual fee of two dollars be collected from those members who were unable to attend the meetings, unless proceedings were published, in which case the full fee be collected, and that not more than double the annual fee be collected from members in arrears. Carried unanimously.

Afternoon Programme—First Day

Paper: Common Types of the Cereal Root Rot Disease and Possible Control Measures; P. M. Simonds, Dominion Plant Pathology Laboratory, Saskatoon.
Discussion led by T. C. Vanterpool.

Report of the Committee on Plant Pathology and Physiology; W. P. Fraser.

Address on Canadian Grain in the Markets of the World. Dean W. J. Rutherford, Saskatoon.

The remainder of the afternoon was devoted to a session on the Influence of Soil Type on Crops and Crop Pests.

Paper: Weed Distribution and Crop Character as Related to Soil Type, A. H. Joel, University of Saskatchewan.
Discussion led by F. H. Edmunds.

Paper: Insect Losses in Relation to Soil Type in Saskatchewan: E. H. MacMillan, Dominion Entomological Laboratory, Saskatoon.
Discussion led by S. H. Vigor.

Paper: Fertilizers for Wooded Soils: A. S. Ward, University of Alberta.
Discussion led by H. Larson.

An announcement was then made by Professor T. J. Harrison regarding seed that was needed for the National Research Council's work on milling and baking quality of wheat.

In the evening the standing committees met separately for committee work. Following this a number of the members took part in a curling tournament on the University rinks.

Morning Programme—Second Day

Paper: Chemical Weed Killers; S. H. Vigor, Department of Agriculture, Regina.
Discussion led by T. Thorvaldson.

The rest of the forenoon was occupied by a session on Milling and Baking Quality of Wheat as Affected by Weather Factors.

Paper: The Effect of Weathering and Frost on the Milling and Baking Quality of Wheat. R. K. Larmour, University of Saskatchewan.
Discussion led by Dean W. J. Rutherford and R. Harris.

Paper: The Influence of Heat Drying on Milling and Baking Quality of Wheat; W. A. Geddes, Manitoba Agricultural College.
Discussion by T. Thorvaldson.

Afternoon Program—Second Day

Paper: The Tendency Toward Increased Size of Farm and the Use of Power Machinery; J. G. Taggart, Dominion Experimental Station, Swift Current, Sask.
Discussion led by W. H. Fairfield.

Paper: Cytological Basis of Some Difficulties in Breeding; W. P. Thompson, University of Saskatchewan.
Discussion led by J. B. Harrington.

Paper: Methods of Evaluating Malting Barley; T. J. Harrison, Manitoba Agricultural College.
Discussion led by E. C. Sackville.

Paper: A Smooth Awned Wheat; S. J. Sigfusson, Dominion Experimental Farm, Brandon, Manitoba.
Discussion led by G. N. Geiszler.

Paper: The Effect of Cutting Garnet Wheat at Different Stages of Maturity and on Consecutive Dates after the Occurrence of Frost; G. E. DeLong, Dominion Experimental Station, Lacombe, Alta.
Discussion led by R. K. Larmour and F. V. Hutton.

Paper: A Method of Removing Borders from Grain Plots; F. M. MacIsaac, Dominion Experimental Station, Scott, Sask.
Discussion led by T. M. Stevenson.

There was no report from the Soils Investigation Committee, the Plant Breeding and Genetics Committee or the Crop and Seed Technology Committee.

Banquet Given by University of Saskatchewan

The members of the society were entertained by the University of Saskatchewan at a banquet in the University dining hall on the evening of December 28th. Very interesting addresses were given by President W. C. Murray of the University of Saskatchewan and Dr. O. S. Aamodt of the University of Alberta.

Morning Program—Third Day

Paper: The Use of Alfalfa as a Means of Ameliorating the Drainage Problem in the Red River Valley; J. H. Ellis, Manitoba Agricultural College.
Discussion led by L. E. Kirk.

The report of the Committee on Instruction and Extension was given by Professor M. Champlin. The Committee recommended that there be a half day symposium next year for the consideration of extension and teaching problems. The report was adopted.

The report of the Committee on Field Experimentation was given by Professor T. J. Harrison. It took the form of a comprehensive paper on the Junior Coöperative Work in Manitoba.

Business Session

The remainder of the morning was occupied by business.

The report of the Nominations Committee was presented by Mr. W. H. Fairfield as follows:

Honorary Presidents:

President W. C. Murray, University of Saskatchewan.
President J. A. McLean, University of Manitoba.
President R. C. Wallace, University of Alberta.

Honorary Vice-Presidents:

Dean E. A. Howes, University of Alberta.
Dean W. C. McKillican, Manitoba Agricultural College.
Dean W. J. Rutherford, University of Saskatchewan.

General Executive:

President—M. J. Tinline.
Vice-President—J. B. Harrington.
Secretary-Treasurer—O. S. Aamodt.
Curator—J. D. Newton.
Executive—R. Newton and P. M. Simmonds.

Standing Committees:

Instruction and Extension—T. J. Harrison and James Murray.
Field Experimentation—M. Champlin, D. G. Matthews and G. E. DeLong.
Plant Breeding and Genetics—J. B. Harrington, J. R. Fryer and A. T. Elders.
Soils Investigations—F. A. Wyatt, A. H. Joel, J. H. Ellis and S. Barnes.
Crop and Seed Technology—G. M. Stewart, J. E. Blakeman and A. MacPherson.

Plant Pathology and Physiology: R. Newton, W. P. Fraser, J. H. Craigie and G. B. Sanford.

It was moved by W. H. Fairfield and seconded by L. E. Kirk that these men be elected. Carried unanimously. Mr. G. M. Stewart then retired as President of the Society and Mr. M. J. Tinline, the President-elect, took the Chair.

The report of the Membership Committee was presented by Dr. J. B. Harrington, as follows: That the following persons are considered to be eligible for membership in the Society and that the Society will accept any of them as members upon receiving from them payment of the annual dues, and that the executive is empowered to add to this list at any time: (A list of seventy-five names of prospective members was read). Moved by J. B. Harrington, seconded by J. H. Ellis that this report be adopted as read. Carried.

Resolutions

Professor A. H. Joel gave the report of the resolutions committee as follows:

1. *Whereas* the Secretary-Treasurer of this Society has to undertake an immense amount of work in connection with his office, particularly in preparing for the annual meeting and the publication of the papers,

And Whereas we the members of the society cannot express our appreciation of services rendered in a proper financial manner, *be it resolved* that as a token of our appreciation we make each Secretary-treasurer, who has filled the office for at least one year, a life member of the society and that this regulation be made retroactive, the life membership for all past Secretary-Treasurers to date from December, 1928.

Moved T. J. Harrison, seconded by W. H. Fairfield. Carried unanimously.

2. *Whereas* the annual loss from weeds in Canada is very great *and whereas* there are many areas of wild land which are polluted with weeds that at present are not being effectively controlled and are spreading to cultivated lands, *and whereas* there has been very little investigation made as to cheap and effective methods of control, *be it resolved* that we ask the Dominion Research Council to initiate a programme to determine satisfactory methods of weed eradication.

Moved by A. H. Joel, seconded by J. H. Ellis. Carried.

3. Resolutions of appreciation to University of Saskatchewan, to the society's executive officers and to the assisting stenographer.

4. *Whereas* there is considerable difference of opinion on the amount and place of mixing of wheat varieties in commercial shipments,

And Whereas there is also considerable difference of opinion on the effect of this mixing on the milling and baking quality and the blending value of these mixtures, *and whereas* some of this work has been done but no publication issued, therefore *be it resolved* that this Association commend this work and suggest that the results be published as soon as possible, *and that* this Society undertake to arange a coöperative investigation (including among the coöperators the Dominion Seed Branch, the Canadian

Coöperative Wheat Producers, the Cereal Chemists of the Universities, the Dominion Experimental Farms and the Agronomy Departments of the Universities) to determine:

1. The amount and kind of mixing taking place on (a) farms, (b) the country elevators, (c) the terminal elevators, (d) the transfer and ocean port elevators.
2. The milling and baking quality and the blending value of these mixtures in comparison with pure varieties, *and that* a committee be appointed to arrange for this investigation and present a report to this Society at the next annual meeting.

Moved by T. J. Harrison, seconded by A. T. Kemp. Carried.

The following organization committee was appointed by the executive to arrange for the investigation on the mixing of varieties of wheat in commercial shipments according to the resolution passed in this connection: Professor T. J. Harrison, Dr. L. E. Kirk, Mr. H. S. Fry, Mr. M. J. Tinline, Dr. J. B. Harrington and Dr. O. S. Aamodt.

This Committee drew up a working basis for the investigation and appointed the following committee of three to succeed it and get the investigation started: Dr. J. B. Harrington, Professor T. J. Harrison and Mr. W. H. Fairfield.

Financial Report

The financial report was given by the Secretary-Treasurer as follows:

Receipts:

By check from J. H. Ellis	$213.92	
Interest to Nov. 30, 1928	3.63	
Membership dues to Dec. 29, 1928	147.85	$365.40

Expenditures:

Stamps, Stationery, mimeography and stenography	$24.60	
Programs for meetings	14.94	
Smokes, music and program for banquet	32.65	
		72.19
Balance in Bank		$293.21

It was moved and seconded by the auditors, H. Larson and S. Barnes that this report be adopted. Carried.

Unfinished Business

Last year's tabled motion regarding holding the annual meeting at the time and place of the annual convention of the Canadian Society of Technical Agriculturists was left tabled after some discussion.

Special Motions

Several special motions were made as follows:

1. Moved by J. B. Harrington and seconded by A. H. Joel that the Secretary-Treasurer send each member, who is in arrears, a statement of such arrears, at least once and preferably twice between annual meetings. Carried.

2. Moved by J. B. Harrington and seconded by L. E. Kirk that the society purchase through the Secretary-Treasurer fifty reprints of each paper given at the meetings of the society as soon as it is published and have these reprints sent directly to the society's Curator for free distribution to members of the society or such other interested parties as libraries or technical agriculturists upon written request from them. Carried.

3. Moved by M. Champlin and seconded by J. B. Harrington that a gavel be obtained for the President. Carried.

4. Moved by J. H. Ellis and seconded by N. F. Bell that the society accept the invitation of President Wallace to meet at the University of Alberta for the 1929 annual meetings and that the meeting be held at the usual time, the dates to be determined by the executive.

J. B. Harrington.
Secretary.

BOOK REVIEW

Lehrbuch der Agrikulturchemie. IV. Teil. Futtermittellehre. – Dr. E. Haselhoff. Berlin Gebrüder Bornträger 1929. (Textbook of Agricultural Chemistry. Part IV. Feeding Stuffs.)

A review of Part I of this textbook dealing with plant nutrition (by E. Blanck) appeared in No. 8, Vol. VIII, of *Scientific Agriculture*. What was said of the arrangement of the subject matter, and particularly the pleasing style and conciseness of expression, may also be said of Part IV just off the press, although it is written by the other of the two authors.

The book does not pretend to deal at all extensively with nutrition. In the introduction a short historical review on the development of animal nutrition provides the student with the information necessary for the evaluation and description of feeding stuffs, to which the main part of the volume is given over.

Canadian readers will find much of interest in the definitions of feeds as adopted by the Association of German Experiment and Control Stations, which are given in every instance. The same applies to the frequent references to provisions of the new German Feeding Stuffs Law, which provide an interesting side-light on the handling of feeding stuffs control in that country.

The final chapter on the evaluation of feeds reflects to a certain measure the unsatisfactory economic condition of Germany's agriculture, which forces the farmer to exercise the greatest care in the purchase of concentrates in order to feed with profit. It is well that economic phases of technical questions should be dealt with in such books, which heretofore have been devoted to technique exclusively.

F.T.W.

CONCERNING THE C.S.T.A.

Owing to ill health, Professor H. M. Nagant has not been able to edit the French material for this issue. The entire issue is therefore composed of English articles. The French section will be resumed in the April number.

Dr. E. S. Archibald, President of the Society, returned to Ottawa on February 23rd, after attending meetings of local branches in western Canada. He was very much impressed with his trip and very enthusiastic as to the future development of all locals and the extension of their activities. He has attended meetings of the following local branches during January and February: Macdonald College, Eastern Ontario, Northwestern Ontario, Manitoba, South Saskatchewan, North Saskatchewan, Alberta and British Columbia.

Activities of Locals.

The Quebec local branch is holding a banquet in the Parliament Buildings, Quebec, on Tuesday evening, March 5th, at which Dr. Archibald will be the guest of honour.

The Western Ontario local held a dinner and debate on the evening of February 22nd, at the Ford Hotel, Toronto. The resolution was: "That corporation farming is in the best interests of Ontario agriculture." The affirmative was supported by Messrs. A. Leitch and S. E. Todd, and the negative by Messrs. E. K. Hampson and Paul Fisher. The judges were Dr. J. B. Reynolds, Mr. T. A. Russell and Mr. W. L. Smith. Their decision was in favour of the affirmative.

Members of the Eastern Ontario local heard an address by Dr. J. M. Swaine, Associate Dominion Entomologist, at a dinner on February 22nd, on "Some observations on agriculture and forestry in Australia and New Zealand." The dinner was followed by a debate on the following resolution: "That all material prepared for publication by Government agricultural institutions in Canada for the farming public should be submitted to and approved by a joint board (or boards) of censors." The affirmative was upheld by Messrs. R. A. Derick and W. C. Hopper and the negative by Messrs. F. C. Nuninck and W. M. Cockburn. A popular vote awarded the decision in favour of the negative side.

Local branches are expected to hold their annual meetings during the next two monthhs for the purpose of electing officers, appointing delegates to the Winnipeg Convention and transacting matters of business. Members will find in each issue of this journal a page giving the names and addresses of all local and Dominion officers. Changes will be made as soon as the results of local branch elections are forwarded to the Central Office.

Notes and News.

E. W. Jones (Manitoba '11), formerly Manager and Secretary of the Alberta Stockyards at Calgary, has been appointed Superintendent of Agriculture and Animal Industry for the Canadian Pacific Railway Co., with headquarters at Calgary, Alta.

Roland Belzile (Laval '26), who has been Live Stock Promoter with the Dominion Live Stock Branch at St. Fabien, Rimouski Co., for the past year, has been transferred to Rivière du Loup, P.Q.

E. J. Rigby (Manitoba '23), has joined the staff of the De Laval Company in Winnipeg. His address is 403 Burnell St., Winnipeg, Man.

C. H. Lavoie (Laval '24), has changed his address to 27 Avenue Ste-Genevieve, Quebec, P.Q.

F. E. M. Robinson (Cambridge '16), was elected President of the National Dairy Council of Canada at the annual meeting of the Council held at Vancouver, B.C. on February 12th, last. Mr. Robinson was Vice-President last year.

G. C. Warren (Toronto '27), has been appointed to take charge of the new landscape work being planned at Acadia University, Wolfville, N.S. His new duties commenced on February 1, 1929 and his mailing address is P. O. Box 245, Wolfville, N.S.

G. A. Ewart (Manitoba '14), who for the past ten years has been District Agriculturist under the Dominion Land Settlement Branch at Regina, Sask., has received the appointment of Publicity Commissioner for Regina. He took over his new duties on February 1, 1929.

F. W. Walsh (Toronto '22), formerly Eastern Agricultural Agent of the Canadian National Railways, has been made Superintendent of Agriculture for the Department of Colonization, Canadian National Railways, Montreal, P.Q.

G. V. Van Tausk (New Zealand '99) has been appointed District Supervisor of Agricultural Instruction at Penticton, B.C., his new duties commencing on February 1, 1929.

J. Roy West (Manitoba '26) who is taking the regular three year course at the Ontario Veterinary College, has been obliged to return to his home at Ogilvie, Man., on account of ill health.

Robert Raynauld (Montreal '21) has accepted the appointment of Associate Editor of "La Terre de Chez Nous," the official journal of L'Union Catholique des Cultivateurs in Montreal. His mailing address is 1231 Demontigny Street East, Montreal, P.Q.

C. C. Kelley (Alberta, '25), who has been District Agriculturist for the past two years at Wiliams Lake, B.C., has been transferred to Prince George, B.C.

Dr. H. Barton (Toronto '07) has been awarded the Order of Agricultural Merit (Commander) by the Quebec Government.

Student Members.

In 1925, the C.S.T.A. made a provision in its by-laws for student membership, to include " those who are senior students pursuing a degree course at an agricultural college of recognized standing." Since that time there have been 117 applications for this class of membership and most of these student members have become regular members shortly after graduation.

Following is a list of student members now completing their degree course in the various colleges in Canada, graduating in 1929. The subject in which each is specializing is given in brackets:—

Manitoba Agricultural College, Winnipeg, Man.

Cornish, J. N. (Animal Husbandry)
Denike, G. N. (Agronomy)
Hagborg, W. H. (Plant Pathology)
Parker, G. H. (Animal Husbandry)
Rogers, C. N. (Animal Husbandry)
Shirriff, C. (Animal Husbandry)
Strachan, B. B. (Economics)

Macdonald College, P.Q.

Finlayson, L. R. (Entomology)
Fitzpatrick, R. E. (Plant Pathology)
Hawkes, Miss M. E. M. (Animal Husbandry)
Holcomb, R. (Chemistry)
Howatt, J. L. (Plant Pathology)
McCormick, R. B. (Plant Pathology)
McMaster, Norman B. (Bacteriology)
Paige, E. G. (Horticulture)
Taylor, C. F. (Plant Pathology)
Whitehead, W. E. (Entomology)

Ontario Agricultural College, Guelph, Ont.

Sawyer, Frank D. (Chemistry)

University of Alberta, Edmonton, Alta.

Holowaychuk, N. (Animal Husbandry and Agricultural Economics)
Hopkins, J. W. (Plant Biochemistry)
Kilduff, Thomas (Field Crops and Plant Pathology)
Lewis, E. R. (Field Crops and Agricultural Engineering)
McCalla, A. G. (Plant Biochemistry)

University of British Columbia, Vancouver, B.C.

Black, Lindsay M. (Plant Pathology)
Yarwood, Cecil (Plant Pathology)

University of Saskatchewan, Saskatoon, Sask.

Armstrong, John M. (Field Husbandry)
Jaap, R. George (Poultry Husbandry)
Ramsay, Rupert (Animal Husbandry)
Robinson, G. Hugh (Agronomy)

Life Membership

No provision was made for Life Membership in the Society until 1927. In that year a clause was added to the by-laws permitting any regular member to become a Life Member by contributing a sum of One Hundred Dollars ($100.00). It was felt that a number of members might be disposed to make this payment to the Society, either in a lump sum or in four quarterly instalments of $25.00 each, thereby avoiding any further bother about annual fees. Life membership fees were to be placed in a savings account and invested from time to time in some safe form of security.

During the past two years only four members have taken out Life Membership — Mr. B. Leslie Emslie, Mr. Fred. H. Grindley, Dr. L. S. Klinck and Mr. H. E. Lefèvre. An appeal is now made to all regular members who can afford it, to show their faith in the C.S.T.A. by making application for life membership before May 31st, 1929. We want to build up a sinking fund with these monies, so that in years to come the Society may derive a constant annual income from a new source. If we could enrol fifty Life Members each year, our finances twenty years hence would justify the establishment of ten annual scholarships of $600.00 each, endowed by our own Life Members. That is only one way in which the revenue might be used; others will naturally suggest themselves.

Who's Who

Before March 31, the General Secretary will mail to every regular member of the Society a draft of his biography as it has been prepared for the second C.S.T.A. Who's Who, to be published next May. These biographies have been prepared from information available at the Central Office and are referred to members in order that they may be checked and brought up to date. Members will assist greatly by returning their biographies promptly so that final publication may not have to be delayed.

Membership

On February 28, 1929, the total membership of the Society was 1,054 (1,025 regular members and 29 student members) as compared with a membership on June 1, 1928 of 1,023 (989 regular members and 34 student members). Between now and June 1, 1929, the names of a number of members will have to be removed from the active list for non-payment of fees and our aim is to keep the list at approximately 1,000 regular members, all of whom will be in good standing when the year ends on May 31, 1929. Members who do not hold their membership cards for 1928-29 should send in their fees at once without waiting for further notices either from the Central Office or from their local secretary.

There is no particular reason for "high pressure" membership campaigns as long as a total membership of 1,000 can be maintained. By replacing resignations with new members a stronger membership spirit will be developed each year. That would appear to be a very desirable policy to follow.

The Annual Convention

There have been no important developments in the Convention programme since the publication of the February issue. Further announcements will be made in these pages next month. In the meantime members who are planning to attend the Winnipeg Convention, especially those from outside provinces, should notify the General Secretary.

C.S.T.A. Headquarters

It is unfortunate that the Society has never been able to maintain a suitable headquarters at Ottawa, where the executive offices would be located and where any member could report when he came to the Capital. Obviously it is a question of finance. Between 1922 and 1924 the General Secretary was obliged to use his own home as an office and since 1924 has used a small room in an old Government building that is likely to be torn down within a year. With the growth of the Society the need for adequate office accommodation has become imperative, and if the rental of suitable offices can be financed in some way, the arangement should also include certain facilities for members coming to Ottawa: (1) a Board Room in which any agricultural committee or group could meet, (2) a lounge room, (3) a reading and writing room. Such conveniences would induce visiting members to report at their own headquarters. The establishment of headquarters and executive offices would also greatly facilitate the work of the General Secretary and give more publicity to the existence of the Society and to the work that it is doing.

Since October, 1928, a special effort has been made to secure funds to meet this need, and it would appear reasonably safe to announce that headquarters will be made available within the next three months and will be financed, both as to rental and equipment, for a period of five years. Further particulars will be available in another month, at which time a definite statement will be made.

AVIS

Nous prions les lecteurs de la Revue Agronomique de nous excuser de l'absence de la partie française dans la livraison du mois de mars. Une collaboration sur laquelle nous comptions n'a pu être livrée à temps en forme voulue pour l'impression. De plus, le rédacteur français ayant été souffrant et obligé de s'absenter pendant deux semaines au cours du mois de février, a été dans l'impossibilité de suppléer lui-même à la matière qui fit défaut.